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CATECHISM OF ZOOLOGY.

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CATECHISM OF ZOOLOGY.

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PREFACE.

THE following "CATECHISM OF ZOOLOGY" is intended to contain such main facts only as it may reasonably be hoped may be retained in the memory of such as have gone through a course of Zoology, until by the study of particular branches they can verify or supplement them by their own observation.

It is not intended to be used alone, but as a summary of what has been enlarged upon by a teacher or related in a text-book. It may be also useful as furnishing categorical answers to questions which can only be answered by inference in many cases from an ordinary text-book.

Nowhere more than in Natural History is it true that no rule is without exception—such exceptions to a general statement, when considered important, have been indicated by the qualifying words, 'almost,' 'generally,' &c., but some have

been passed over as tending to confuse the idea of the general truth.

The classification adopted is nearly that of Nicholson's Manual, to which I am much indebted, but modified where thought advisable with the authority either of Owen's 'Comparative Anatomy,' Huxley's 'Outlines,' or Rolleston's 'Forms.'

J. F. B.

York: *August* 8, 1872.

TABULAR VIEW

OF

THE ANIMAL KINGDOM.

Sub-Kingdom I.—*PROTOZOA.*

Class I.—Gregarinida.

Class II.—Rhizopoda.

Order 1. Amœbea.
„ 2. Foraminifera.
„ 3. Radiolaria.

Class III.—Porifera.

Class IV.—Infusoria.

Order 1. Ciliata.
„ 2. Suctoria.
„ 3. Flagellata.

Sub-Kingdom II.—*CŒLENTERATA.*

Class I.—Hydrozoa.

Order 1. Hydroida.
„ 2. Siphonophora.
„ 3. Discophora.
„ [4. Graptolitidæ.]

Class II.—Actinozoa.

Order 1. Zoantharia.
„ 2. Alcyonaria.
„ [3. Rugosa.]

Class III.—Ctenophora.

Sub-Kingdom III.—*ANNULOIDA.*

Class I.—Echinodermata.

Order 1. Echinoidea.
„ 2. Asteroidea.
„ 3. Ophiuroidea.
„ 4. Crinoidea.
„ 5. Holothuroidea.
„ [6. Cystoidea.]
„ [7. Blastoidea.]

Class II.—Scolecida.

Sub-Class I.—Helminthozoa.

Section I.—Platyelmia.

Order 1. Tæniada.
„ 2. Trematoda.
„ 3. Turbellaria.

Section II.—Nematelmia.

Order 4. Acanthocephala.
„ 5. Gordiacea.
„ 6. Nematoda.
„ 7. Chætognatha.

Sub-Class II.—Rotifera.

Sub-Kingdom IV.—*ANNULOSA.*

Division I.—Annelida.

Order 1. Gephyrea.
„ 2. Hirudinea.
„ 3. Oligochœta.
„ 4. Tubicola.
„ 5. Errantia.

Division II.—Arthropoda.

Class I.—Crustacea.

Sub-Class I.—Pectostraca.

Order 1. Cirripedia.
„ 2. Rhizocephala.

Sub-Class II.—Entomostraca.

Order 3. Epizoa.
„ 4. Ostracoda.
„ 5. Copepoda.
„ 6. Cladocera.
„ 7. Phyllopoda.
„ [8. Trilobita.]

Sub-Class III.—Merostomata.

Order 9. Xiphosura.
„ [10. Eurypterida.]

Sub-Class IV.—Malacostraca.

Section I.—Edriophthalmata.

Order 11. Læmodipoda.
„ 12. Amphipoda.
„ 13. Isopoda.

Section II.—Podophthalmata.

Order 14. Stomapoda.
„ 15. Decapoda.

Class II.—Arachnida.

Sub-Class I.—Trachearia.

Order 1. Podosomata.
„ 2. Monomerosomata.
„ 3. Adelarthrosomata.

Sub-Class II.—Pulmonaria.

Order 4. Pedipalpi.
„ 5. Araneida.

Class III.—Myriapoda.

Order 1. Chilopoda.
„ 2. Chilognatha.

Class IV.—Insecta.

Sub-Class I.—Ametabola.

Order 1. Anoplura.
„ 2. Mallophaga.
„ 3. Thysanura.

Sub-Class II.—Hemimetabola.

Order 4. Hemiptera.
„ 5. Orthoptera.
„ 6. Neuroptera.

Sub-Class III.—Holometabola.

Order 7. Aphaniptera.
„ 8. Diptera.
„ 9. Lepidoptera.
„ 10. Hymenoptera.
„ 11. Strepsiptera.
„ 12. Coleoptera.

Sub-Kingdom V.—*MOLLUSCA.*

Division I.—Molluscoida.

Class I.—Polyzoa.

Order 1. Phylactolæmata.
„ 2. Gymnolæmata.

Class II.—Tunicata.

Class III.—Brachiopoda.

Order 1. Inarticulata.
„ 2. Articulata.

Sub-Kingdom V.—*MOLLUSCA* (continued).

Division II.—Molluscа Proper.

Class IV.—Lamellibranchiata.

Class V.—Gasteropoda.

Sub-Class I.—Branchifera.

Order 1. Prosobranchiata.
„ 2. Opisthobranchiata.
„ 3. Nucleobranchiata.

Sub-Class II.—Pulmonifera.

Class VI.—Pteropoda.

Class VII.—Cephalopoda.

Order 1. Dibranchiata.
„ 2. Tetrabranchiata.

Sub-Kingdom VI.—*VERTEBRATA.*

Division I.—Ichthyopsida.

Class I.—Pisces.

Order 1. Cirrostomi.
„ 2. Cyclostomi.
„ 3. Teleostei.
„ 4. Ganoidei.
„ 5. Placoidei.
„ 6. Dipnoi.

Class II.—Amphibia.

Order 1. Ophiomorpha.
„ 2. Urodela.
„ 3. Anura.
„ [4. Labyrinthodontia.]

Division II.—Sauropsida.

Class III.—Reptilia.

Order 1. Chelonia.
„ 2. Ophidia.
„ 3. Lacertilia.
„ 4. Crocodilia.
„ [5. Ichthyopterygia.]
„ [6. Sauropterygia.]
„ [7. Anomodontia.]
„ [8. Pterosauria.]
„ [9. Dinosauria.]

Class IV.—Aves.

[Sub-Class I.—Saururæ.]

Sub-Class II.—Ratitæ.

Order 1. Cursores.

Sub-Class III.—Carinatæ.

Order 2. Natatores.
„ 3. Grallatores.
„ 4. Rasores.
„ 5. Scansores.
„ 6. Insessores.
„ 7. Raptores.

Class V.—Mammalia.

Sub-Class I.—Implacentalia.

Order 1. Monotremata.
„ 2. Marsupialia.

Sub-Class II.—Placentalia.

Order 3. Rodentia.
„ 4. Insectivora.
„ 5. Cheiroptera.
„ 6. Bruta.
„ 7. Cetacea.
„ 8. Sirenia.
„ 9. Proboscidea.
„ 10. Perissodactyla.
„ 11. Artiodactyla.
„ 12. Carnivora.
„ 13. Quadrumana.
„ 14. Bimana.

CATECHISM OF ZOOLOGY.

INTRODUCTION.

1. INTO what two kinds are natural objects divided?

Plants and Animals are called Organic, and Minerals Inorganic bodies.

2. How are they distinguished from each other?

Organic bodies are such as have in themselves an inherent tendency to change.

Inorganic bodies are unchangeable, unless acted on from without.

3. How are Plants distinguished from Animals?

Plants derive their nourishment directly from inorganic materials.

Animals require organic food.

4. Is this their only difference?

Many other characters distinguish them *in general*, but none so universally as this.

5. Into what sub-kingdoms are Animals now divided?

Into six: viz., *Vertebrata*, *Mollusca*, *Annulosa*, *Annuloida*, *Cœlenterata* and *Protozoa*.

6. What are the *Vertebrata*?

They are animals which have a jointed backbone to protect a nervous cord: such as fishes, reptiles, birds and quadrupeds.

7. What are the *Mollusca*?

They are soft-bodied shell-fish, whose nerve centres are situated irregularly about their body: such as the cuttle-fish, whelk and oyster.

8. What are the *Annulosa*?

They are animals whose straight long bodies are divided into joints, with two nerve centres for each: such as insects, spiders, shrimps and worms.

9. What are the *Annuloida*?

They are animals of various shape, with a simple nervous system: such as sea-urchins and starfishes.

10. What are the *Cœlenterata*?

They are animals of simple structure, with the mouth in the centre, and their bodies hollow: such as the jelly-fishes, corals and sea-anemone.

11. What are the *Protozoa*?

The simplest of all animals, with very little structure: such as the sponges and animalcules.

12. What common name is often given to all these last five sub-kingdoms?

'*Invertebrata.*'

13. What are the chief 'systems' in the structure of an animal?

The alimentary system, for feeding; the locomotive system, for moving; the circulatory

system, for carrying about the blood; the respiratory system, for breathing; the nervous system, for feeling; and the reproductive system, by which the young are formed.

PROTOZOA.

1. Why are the *Protozoa* so called?

Because being the simplest they are usually studied first.

2. What is the substance they are made of called?

'*Sarcode*': a substance like the white of egg (albuminous).

3. What 'systems' are not found in them?

The circulatory, respiratory and nervous systems.

4. Into what classes are they divided?

The *Gregarinida*, *Rhizopoda*, *Porifera* and *Infusoria*.

5. What are the *Gregarinida*?

They are minute oval bodies, without mouth or structure of any kind, except a dark spot, called 'the *nucleus*.'

6. Where are they found?

In the bodies of worms, insects, &c.

7. Why are the *Rhizopoda* so called?

Because they can shoot out long threads of their substance which look like roots, and by which they move.

8. What are these threads called?

'*Pseudopodia*,' or false feet.

9. What is the size of these animals?

They are mostly microscopic.

10. How do they feed?

When their pseudopodia touch a particle of food they stick to it, and surround it, they are then drawn into the body, and the food with them; it is then placed in a cavity in the body made for it, where it is digested, and the remainder is ejected by an opposite process.

11. How do they move?

By extending their pseudopodia on one side, and contracting them on the other.

12. How do they increase?

They either divide into two, or some of their pseudopodia join together into one mass, which then breaks off.

13. Into what orders are the *Rhizopoda* divided?

The *Amœbea*, the *Foraminifera* and the *Radiolaria*.

14. What are the *Amœbea*?

They are microscopic fresh-water animals, which do not form hard shells, and have short pseudopodia, which do not join together into one when they touch each other.

15. Why are they so called?

Because they are perpetually changing their shape, by putting out their thick pseudopodia from different parts of their body.

16. What structure do they show?

They consist of two layers: an outside, or '*ectosarc*,' and an inside, or '*endosarc*'; they have also a dark spot, or '*nucleus*,' and one or more

'*contractile vesicles*,' which continually contract and expand.

17. What peculiar power have they in their pseudopodia?

That of stunning their prey.

18. What are the *Foraminifera*?

They are marine animals, which form beautiful shells of carbonate of lime.

19. Why are they so called?

Because their shells are pierced with holes or '*foramina*' for the passage of their pseudopodia.

20. What structure do they show?

None at all in their bodies, but the shells they form are often very complicated.

21. What other name have they received?

'*Reticularia*,' because their pseudopodia join and interlace, so as to form a network.

22. Where are their shells found?

In all sea sands, and also fossil, in rocks, especially chalk.

23. Which is the most remarkable of the fossil *Foraminifera*?

The Nummulites, so called from their resemblance to a coin: whole mountains are formed of their remains, and the Pyramids are built of stone filled with them, they are among the largest of the Foraminifera.

24. Describe the shell of a Foraminifer.

It consists either of a single '*cell*,' with an opening at one end for the pseudopodia, or of a number of 'cells' communicating with each other by foramina, and lying in a straight line, a curve,

a spiral, or irregularly, often having ornaments on the outside.

25. Into what sections are they divided?

Into the '*Perforata*' or '*vitreous*,' the '*Imperforata*' or '*porcellanous*,' and the '*Arenaceous*.'

26. How are the Imperforata distinguished?

The walls of each cell are not perforated for the pseudopodia, which can only be put out at the main opening, in the last cell; they look like porcelain.

27. How are the Perforata distinguished?

They have minute openings all over every cell, out of which the pseudopodia are put. They are often transparent and glassy.

28. How are the Arenaceous ones distinguished?

They do not form a true shell, but only glue together small particles of sand to form a covering in the shape of a shell.

29. Why are the *Radiolaria* so called?

Because their pseudopodia, instead of forming a network, stand out straight from the body like rays.

30. Into what families are they divided?

The *Acanthometrina*, the *Polycystina*, and the *Thalassicollida*.

31. Describe the *Acanthometrina*.

They are minute, soft, often highly coloured, round or star-shaped bodies, with large, flinty (siliceous) spines extending beyond them like thorns.

32. Describe the *Polycystina*.

They form beautiful siliceous shells; covered with large openings, out of which their straight

pseudopodia are put; and often having spines and other ornaments.

33. Why are they so called?

Because many of them have two or more shells one inside the other.

34. How are they distinguished from the *Foraminifera*?

Their shells are siliceous and not calcareous; their openings or foramina are much larger; and their pseudopodia are straight and thick, instead of being thin and interlacing,

35. What are the *Thalassicollida*?

Sea-jellies, without much shape, with flinty spines and pseudopodia about their surface; some are simple and some compound.

36. When is an animal called '*compound*'?

When it is composed of several similar parts, each of which appears capable of living apart from the rest.

PORIFERA.

1. Where are the Sponges found?

Growing to rocks at the sea bottom, whence they are cut by divers.

2. Why are they called *Porifera*?

Because they are full of small holes, called '*pores*.'

3. What three parts do they consist of?

The horny fibre, the spicules, and the sponge-flesh.

4. What is the horny fibre?

It is a mesh of fine threads which interlace so as to leave some narrower and some wider passages between. It is this part of the sponge that we ordinarily use.

5. What are the spicules?

They are narrow flinty particles of various shapes, imbedded in the horny fibre and sponge-flesh, and serve to strengthen the sponge.

6. What is the sponge-flesh?

It is a soft, albuminous substance surrounding the horny fibre, and so lining the passages. It is formed of a number of small particles, some of which have fine hair-like extensions, called '*cilia*,' and some throw out pseudopodia.

7. How does the sponge feed?

By the motion of the cilia a current is formed, which enters by the smaller openings or '*pores*,' and goes out by the larger ones or '*oscula*,' after passing through the passages of the sponge; and particles of food brought in by these currents are stopped by the sponge particles.

8. How do sponges increase?

A seed-like body, protected by wheel-shaped spicules, is formed in the sponge-flesh, in which eggs are developed; and when the old sponge dies and spring returns, they are carried to some new ground, where they develop into fresh sponges; they also increase in other ways.

9. What other sponges are there besides the ordinary kind?

There are some whose skeleton is made only of carbonate of lime, and others whose skeleton is all siliceous; the most beautiful of which latter is the *Euplectella*, or Venus' flower-basket.

INFUSORIA.

1. Why are the *Infusoria* so called?

Because they are always found in infusions of organic matter in water.

2. Are they the only animalcules found in such water?

No; but they are the commonest and most numerous.

3. What character distinguishes them from the Rhizopods.

They have a definite mouth, and cannot take in food at any other part of their body.

4. Into what orders are they divided?

The *Ciliata*, the *Suctoria*, and the *Flagellata*: of which the first are the most numerous and important.

5. Why are the *Ciliata* so called?

Because their bodies are covered by fine vibrating cilia.

6. How many kinds are there?

Two: the free and the fixed.

7. Describe the commonest of the free forms.

This is the *Paramecium*. It has an oval body, with two skins surrounding it, the outer one covered by cilia, the inner one with nucleus and contractile vesicles. There is a mouth at one side leading into a funnel-shaped throat, which is gradually lost in the soft interior.

8. How does it feed?

The motion of the cilia brings a current to its mouth, and so a pellet of food collects at the

bottom of the throat; this is then pushed through into the body, and is carried round till digested, when the remains if any are pushed out through an opening near the mouth.

9. How do they increase?

They generally divide themselves into two, sometimes as often as once a day; so that in a month they may become innumerable.

10. Describe the commonest of the fixed forms.

This is the *Vorticella*. Its structure is like the Paramecium's; but in form it is like a cup on the end of a contractile stalk, which twists up into a spiral. The cilia surround the upper edge of the cup.

11. How does it increase?

In three ways: by division, gemmation, and encystment.

12. Describe the process by division.

The cup gradually divides into two, and a circle of cilia grows at the base of one which floats away, and then forms a stalk.

13. Describe the process by gemmation.

It is similar to division, but the new cup comes by budding at the base of the old.

14. Describe the process by encystment.

The cup closes up its mouth, and becomes a '*cyst*,' the inside of which breaks up into germs, which float away when the cyst breaks.

15. Mention some other interesting Infusorians.

The large *Stentor* or trumpet animalcule, which fixes and detaches itself at will: the *Vaginicola*, which forms a horny case, into which

it can retire; and the *Oxytricha*, which walks by means of bristles.

16. Describe the commonest of the *Suctoria*.

This is the *Acineta*. It is attached to aquatic plants by a stalk, and has a number of tubes standing out of its body, with a sucker at the end of each, by which it sucks the juice of its prey.

17. Describe the commonest of the *Flagellata*.

This is the *Noctiluca*, which is a common cause of the phosphorescence of the sea. It is a kidney-shaped animal, with a mouth in the hollow part, near which is a long lash or '*flagellum*.'

CŒLENTERATA.

1. Why are the *Cœlenterata* so called?

Because their bodies are formed of a hollow bag.

2. What characters have they all in common?

1. The stomach opens freely into the body.
2. Their body is formed of two layers, an 'ectoderm' and an 'endoderm.'
3. Their nervous system is absent or rudimentary.
4. They possess stinging organs, called 'thread-cells.'

[5. Their organs are generally ranged in a circle round their mouth.]

3. Describe the thread-cells.

They are little bags of poison, with a long coiled thread, which is often jagged along the edges.

4. What name has been given to many of the free-swimming forms on account of these?

The *Acalephæ*, or sea-nettles.

5. Into what classes are the *Cœlenterata* divided?

The *Hydrozoa*, the *Actinozoa*, and the *Ctenophora.*

6. Why are the *Hydrozoa* so called?

They are named after the simplest of them, the *Hydra.*

7. What are the common characters of the *Hydrozoa*?

1. Their stomach is formed of their whole body.
2. Their reproductive organs are external.

8. Into what orders are the *Hydrozoa* divided?

The *Hydroida*, the *Siphonophora*, and the *Discophora.*

9. What is the distinguishing character of the *Hydroida*?

1. They are attached to stones or plants by a disc, called the '*hydrorhiza.*'
2. Their tentacles surround the mouth.

[3. They form no 'umbrella' like the *Discophora.*]

10. What are the sub-orders of the *Hydroida*?

The *Hydrida*, the *Corynida*, the *Sertularida*, and the *Campanularida.*

11. What are the *Hydrida*?

They comprise only the varieties of the common *Hydra*, being the simplest of all, and found in fresh water.

12. Describe the *Hydra.*

The *Hydra* is like a short cylinder attached at one end, called the '*proximal*' end, to an aquatic plant; at the other, or the '*distal*' end, is the opening or mouth, surrounded with tentacles, by which they catch their food.

13. How are the *Hydræ* increased?

By gemmation, by eggs, and artificially.

14. Describe the process by gemmation.

A little bud grows at the side of the body, which soon develops tentacles at the other end, and is gradually severed from the body of its parent, and floats away.

15. Describe the growth by eggs.

A little knob arises on the outside of the body in which the eggs are gradually developed, and when mature, the case bursts, and they are scattered through the water.

16. When do these different processes take place?

Gemmation takes place in summer, and the eggs are formed on the approach of winter.

17. How may they be increased artificially?

A Hydra may be cut into several pieces, and each piece will develop into a perfect animal.

18. Is the Hydra absolutely fixed to the stem on which it lives?

No; it can change its station at pleasure, walking upon its tentacles and hydrorhiza.

19. Why are the *Corynida* so called?

Because their distal end is enlarged like the head of a club.

20. How do they differ further from the Hydrids?

They are mostly marine; they are often compound; and often have a hard outer layer called the '*polypary*.'

21. What are the different parts of a compound *Hydroid* called?

The alimentary part, corresponding to the body of a Hydra, is called the '*polypite*,' and the flesh which joins the several polypites together is called the '*cœnosarc*.'

22. How do the *Corynids* increase?

Egg bags, called '*gonophores*,' rise out of the sides of the polypite, or out of the cœnosarc, or on special processes, called '*gonoblastidia*.' These burst, and let the eggs float away.

23. Describe a peculiar process in the development of some of the Hydroids.

The gonophores, instead of perfecting the eggs, open on the outside and form bells, which break off and float away in the sea—looking like small jelly-fishes. It is from the eggs of these jelly-fishes that the fixed Hydroids are again developed.

24. What is this process called?

The '*alternation of generations*.'

25. Why are the *Sertularida* so called?

Because of their plant-like appearance, being often mistaken for seaweed.

26. Describe the *Sertularia*.

It is the most compound of all the Hydroids. Its polypary consists of numerous branches, on each side of which are little hollow cases, in

which the polypites live; scattered about are larger cases, containing the eggs (*gonothecæ*).

27. How are the *Sertularida* and *Campanularida* both distinguished from the *Corynida*?

By the possession of '*hydrothecæ*,' or horny cases, for the protection of each polypite.

28. How are they distinguished from each other?

The *Campanularida* have their hydrothecæ on the end of a stalk. Those of the *Sertularida* have no stalk, *i.e.* are sessile.

29. Why are the *Campanularida* so called?

From their resemblance to a bell.

30. What is another name for the *Siphonophora*?

The oceanic *Hydrozoa*, because they are found floating on the sea, far from land.

31. What are the characters of the *Siphonophora*?

The tentacles do not surround the mouth, and the polypites and floating apparatus are connected together irregularly.

32. Describe a *Siphonophore*.

They are delicate soft creatures, consisting of two parts: the polypites with their tentacles, and the floating apparatus.

33. Describe the polypites and tentacles.

The polypites are long and finger-like, either all together at the proximal end, or distributed along a thread-like cœnosarc; the tentacles arise from the base of the polypites, and are sometimes branched.

34. Describe the floating apparatus.

In some this consists of two or more hollow floating bells, called '*nectocalyces*,' in others of an air-bag, called a '*pneumatophore*.'

35. Describe a nectocalyx and its action.

A nectocalyx is like a bell, with a piece of skin called 'the *veil*,' surrounding the inside of the mouth; by its contraction it expels the water in one direction, so as to drive itself in the opposite.

36. Describe the pneumatophore.

It is a hollow bag, containing another filled with air, at the proximal end of the body.

37. Into what two orders are the *Siphonophora* divided?

The *Calycophoridæ* and the *Physophoridæ*.

38. What is the peculiar organ of the *Calycophoridæ*?

The '*somatocyst*' or hollow bag at the proximal end of the cœnosarc, not filled with air.

39. What is the peculiar organ of the *Physophoridæ*?

The pneumatophore or air-bag.

40. Which is the commonest of the *Siphonophora*?

The *Physalia*, or Portuguese man-of-war, in which the pneumatophore is very large and bladder-like.

41. What are *Medusids*?

They are small jelly-fishes, in the shape of a bell, with the polypite hanging down in the centre like the tongue of the bell.

42. Describe the bell.

It is a nectocalyx with a veil, as in the *Siphonophora*: it is traversed by four canals, which join at the top, and round its circumference the tentacles hang.

43. What are they supposed really to be?

In most, if not in all cases, they are egg-bearing stages in the development of other *Hydrozoa*.

44. Where are the eggs formed?

In coloured bags, which either sprout from the polypite, or lie in the canals of the nectocalyx.

45. Where are the supposed organs of sense?

At the base of the tentacles, where they join the nectocalyx, are little 'vesicles' and pigment spots, supposed to represent ears and eyes.

46. What is the characteristic organ of the *Discophora*?

The '*umbrella*,' so called from its appearance.

47. How does this umbrella differ from a nectocalyx?

1. In the absence of a veil.
2. In having eight or more canals, which branch and form a network, instead of four simpler ones.
3. In having the vesicles and pigment spots united into one covered organ, called a '*lithocyst*.'

48. How did their old names indicate this last character?

These were called Covered-eyed, and the others Naked-eyed 'Medusæ.'

49. What are the three sub-orders of the *Discophora*?

The *Lucernariadæ Pelagidæ*, and *Rhizostomidæ*.

50. Which of these is attached when adult, and which are free?

The *Lucernariadæ* are attached, the others are free.

51. Describe the commonest of the *Lucernariadæ*.

The *Lucernaria* is like an umbrella half closed, attached by its narrowest part to a seaweed, and having bunches of tentacles at eight points in the circumference of the wider end, in the centre of which is the polypite; the space between the polypite and umbrella being divided into compartments.

52. Is it permanently fixed?

No; it can change its station, like the *Hydra*.

53. Describe the commonest of the *Pelagidæ*.

The *Chrysaora* is a large mass of jelly-like flesh, in the shape of an open umbrella; in the centre is the polypite, with four large curled lips hanging down, and round the margin of the umbrella are a number of long tentacles, each with a lithocyst at the base.

54. Describe the commonest of the *Rhizostomidæ*.

The *Rhizostoma* has a large jelly-like, smooth umbrella; from the centre of the underside of which hang down several thick fleshy masses, covered by small polypites.

55. What are the differences between the *Pelagidæ* and *Rhizostomidæ*?

The *Pelagidæ* have but one polypite, and the tentacles hang from the edge of the umbrella. The *Rhizostomidæ* have several polypites, and there are no tentacles on the umbrella.

56. Describe the life-history of some of these two orders.

There is: 1. the 'Planula' stage, when the egg is a flat ciliated disc.

2. The 'Hydra-tuba' stage, when it has fixed itself down by one end, and developed a mouth at the other like a *Hydra*; in this stage it may remain for years.
3. The 'Scyphistoma' stage, when the body is partially divided into segments.
4. The 'Saucer' stage, when the tentacles have been moved to below the saucer-like segments.
5. The 'Medusa' stage, when the saucer floats away.
6. The perfect animal, such as produced the egg.

57. What are *Graptolites*?

They are saw-like markings on Silurian rocks. Each tooth was probably inhabited by a polypite, like the Sertularians.

ACTINOZOA AND CTENOPHORA.

1. Why are the *Actinozoa* so called?

Because their bodies are divided by partitions, running out from the centre like the rays of the sun.

2. How do they differ from the *Hydrozoa*?

1. In having a separate stomach.
2. In having mesenteries.
3. In having the reproductive organs internal.
4. In often forming corals.

3. Describe the stomach.

It is formed by the bending in of the skin at the distal end, and is like a hollow bag open at both ends, suspended in the centre of the animal.

4. Describe the mesenteries.

They are fleshy partitions, extending from the outside of the stomach to the inside of the outer skin.

5. Where are the reproductive organs?

On the side of the mesenteries.

6. What different names are used in the *Actinozoa* and *Hydrozoa* to denote the whole organism?

'*Actinosoma*' and '*Hydrosoma.*'

7. What different names are used in the *Actinozoa* and *Hydrozoa* to denote the alimentary part?

'*Polype*' and '*Polypite.*'

8. What are the orders of the living *Actinozoa*?

The *Zoantharia* and *Alcyonaria.*

9. What are the distinguishing characters of the *Zoantharia*?

1. They have their soft parts in multiples of five or six.
2. Their tentacles are simple.

10. Into what sub-orders are the *Zoantharia* divided?

The *Malacodermata*, the *Sclerobasica*, and the *Scleroderma*ta.

11. What is the character of the *Malacodermata*?

They are soft bodied, not forming corals, as the other sub-orders.

12. What are the three families of the *Malacodermata*?

The *Actinidæ*, the *Ilyanthidæ*, and the *Zoanthidæ*.

13. How are they distinguished?

The *Actinidæ* are attached, but movable; the *Ilyanthidæ* are free swimming; and the *Zoanthidæ* are compound and fixed.

14. Describe a *Sea-anemone* or *Actinia*.

It consists of a cylinder, attached by its 'base' to the rocks, and has its mouth in the centre of the other end or disc. The disc is surrounded by numerous simple tentacles, in alternate rows. The stomach is open below, and is supported in the body by primary, secondary and tertiary mesenteries.

15. Describe the *Ilyanthus*.

It tapers at both ends, and has fewer tentacles than the *Actinia*.

16. Describe the *Zoanthus*.

It is like several small sea-anemones connected by a fleshy creeping cœnosarc.

17. What is the meaning of '*sclerobasic*' and '*sclerodermic*'?

They are applied to two different kinds of

coral: *sclerobasic* are those which form a hard base on which the cœnosarc is supported, and are not formed within the polype; the *sclerodermic* are formed within the polype, by the hardening of its soft parts.

18. What are corals formed of?

Usually carbonate of lime, but sometimes they are partly horny.

19. Describe a *sclerobasic* coral.

It is a solid branching coral, covered during life by a thick skin or cœnosarc which forms it, in which the polypes are imbedded.

20. Are sclerobasic corals formed by any other animals than those belonging to the *Zoantharia sclerobasica*?

Yes; by some of the *Alcyonaria*.

21. How may the corals formed by these two orders be distinguished?

In the *Alcyonaria* the corals are grooved; in the *Zoantharia* they are not.

22. What remarkable animal is reckoned among the *Sclerobasica*?

The *Hyalonema*, or *glass-rope coral*, which is always connected with a sponge.

23. Describe a *sclerodermic* coral.

Each polype forms a cup by the hardening of its skin, so as to form a model of the body-wall and mesenteries; there may be but one, or several, imbedded in a mass of hard coral substance.

24. Explain the meanings of the words employed for the different parts of a sclerodermic coral.

1. The '*corallite*' is the single coral formed by each polype.
2. '*theca*' is its wall.
3. The '*calice*' is the hollow part at the top.
4. The '*septa*' are the pieces which extend from the theca towards the centre.
5. The '*loculi*' are the spaces between the septa.
6. The '*columella*' is the hard axis in the centre.
7. '*tabulæ*' are floors extending from septum to septum, perpendicular to the axis.

25. Are sclerodermic corals formed by any animals besides the *Zoantharia sclerodermata*?

Some of the *Alcyonaria* form imperfect ones.

26. What are the four great groups of Sclerodermic corals?

The *Tabulata*, *Perforata*, *Aporosa* and *Tubulosa*.

27. What is the chief character of each?

1. The *Tabulata* have tabulæ.
2. The *Perforata* are formed of porous substance.
3. The *Aporosa* are formed of non-porous substance.
4. The *Tubulosa* have rudimentary septa.

28. What kinds of coral reef are there?

Fringing reefs, barrier reefs, and atolls.

29. What is the difference between them?

The fringing reefs surround the land closely; barrier reefs are farther out to sea, leaving a deep channel between; atolls are circular reefs, with no land in the centre.

30. How are they formed?

Corals only live at a certain depth, so that all the reef below must have been made when the corals were at that depth, and have since sunk with the land, and the parts above have been broken off from below, and heaped up by the waves.

31. What are the distinguishing characters of the *Alcyonaria*?

1. They have eight tentacles, which are fringed or *pinnate*.
2. Their mesenteries are in multiples of four.

32. Into what families are they divided?

The *Alcyonidæ*, *Tubiporidæ*, *Pennatulidæ* and *Gorgonidæ*.

33. Describe the *Alcyonidæ*.

They are soft-bodied, irregular shaped animals, with microscopic spicules. The commonest is called 'Dead men's fingers.'

34. Describe the *Tubiporidæ*.

These form the 'organ-pipe corals,' consisting of many tubes, connected by transverse plates; each tube becomes soft at the end, and changes to be the skin of the polyp.

35. Describe the *Pennatulidæ*.

They are the 'sea-pens.' Their lower part is a naked stem, which they bury in the sand, and the upper part has many feather-like branches, in which the polypes live.

36. How are they distinguished from the other *Alcyonaria*?

By their being free.

37. Describe the *Gorgonidæ*.

These are the 'sea-shrubs.' They form a branched sclerobasic coral, covered by the cœnosarc, in which are imbedded the polypes. The coral is grooved, and in some is horny; and in some there are also microscopic spicules.

38. What are the *Rugosa*?

They are fossil sclerodermic corals, whose septa were in multiples of four.

39. Why is this sufficient to make them a separate order?

Because in the first character they agree with the *Zoantharia*, and in the second with the *Alcyonaria*.

40. Why are the *Ctenophora* so called?

Because they swim by means of comb-like bands on their surface.

41. What are their characters?

1. Their digestive system is in the form of tubes hollowed out of the body.
2. They possess a rudimentary nervous centre.
3. They have peculiar organs, called '*ctenophores*.'
4. They are more or less two-sided.
5. They have anal openings.

42. Describe the type.

The *Pleurobrachia* is a melon-shaped animal, swimming freely. Its mouth is at one end and 'apex' at the other. It has two long simply branched tentacles, and eight comb-like fringed bands, running lengthwise—the 'ctenophores.'

43. Describe the internal arrangements.

The stomach leads into a wide open tube or funnel, from which three pairs of canals diverge: 1st, the paragastric canals, which run up alongside of the stomach; 2nd, the radial canals; and 3rd, the apical canals, which open externally through the apical pores.

44. What is the course of the radial canals?

They split into two, and then into two again, and so lead into eight canals closed at both ends, which run at right angles to them, and beneath the ctenophores, called the '*ctenophoral canals.*'

45. What peculiar organ is there in the *Ctenophora*?

The '*ctenocyst,*' situated at the apex, and supposed to be a nerve centre and to support an organ of sense.

46. Into what two sections are they divided?

The *Stenostomata* and the *Eurystomata.*

47. How are these distinguished?

1. The *Stenostomata* have small mouths and possess tentacles.
2. The *Eurystomata* have large mouths and no tentacles.

48. What remarkable animal is included amongst the *Ctenophora*?

The *Cestum Veneris*, or Venus' girdle, which is a long band tapering at both ends, with the system of tubes crossing the middle part, where there are also two tentacles.

ANNULOIDA.

1. What are the *Annuloida*?

They are animals of very various shape and differing organisation, grouped together temporarily, as being higher than the *Cœlenterata*, and without the characters of the *Annulosa*.

2. Why are they called *Annuloida*?

Because many of them are like the *Annulosa* in shape.

3. What peculiar system do they seem to have in common?

The 'water-vascular' system, which admits water into a series of tubes within the body.

4. Into what two classes are the *Annuloida* divided?

The *Echinodermata* and the *Scolecida*.

5. Have these two classes much in common?

Not when adult, except their water-vascular system; but in the development of the young they are very similar.

6. What common animals belong to the *Echinodermata*?

The Sea-urchins and Starfishes.

7. Why are the *Echinodermata* so called?

Because their shells are studded with spines like a hedgehog's skin.

8. What are the chief characteristics of the *Echinodermata*?

1. Their alimentary system is completely shut off from the body.
2. Their organs are arranged in a circle.

3. Their parts are in multiples of five.
4. They form calcareous shells or spicules in their skin.
5. They have an '*ambulacral system.*'

9. Into what living orders are they divided?

Echinoids, *Asteroids*, *Ophiuroids*, *Crinoids* and *Holothuroids*.

10. What is the distinguishing character of the *Echinoids*?

They are encased in a hard shell or '*test*,' covered with spines.

11. Describe the *Echinus* test.

It is more or less globular in shape,[1] and is divided longitudinally into ten areas; the five narrower are called the '*ambulacra*,' and the five broader the '*interambulacra*,' and each is divided into two. Each *ambulacrum* has a '*poriferous zone*' on either side. In the centre of the base is generally the mouth, and in the centre of the top is the '*apical disc.*' The interambulacra, and usually the ambulacra, are covered with '*tubercles*,' on which are fitted '*spines.*'

12. What are the poriferous zones?

They are rows of small openings, out of which come the suckers, or tube-feet, by means of which the animal walks.

13. Why are the ambulacra so called?

Because they contain the poriferous zones, and therefore support the tube-feet.

14. Describe the tubercles and spines.

The tubercles are ornamented knobs, like half a ball; the spines are long and cylindrical, and

[1] In some it is nearly flat.

fit on to the tubercles with a ball-and-socket joint, so as to move in any direction; they are of various sizes on the same test.

15. Describe the apical disc.

It contains ten [1] plates. The five larger and inner are called '*genital plates*,' having openings for the passage of eggs, and they lie opposite the interambulacra. The five smaller, which are wedged in between them on the outside, are the '*ocular plates*,' because they are pierced for the eyes, and they are opposite the ambulacra.

16. What is the '*madreporiform tubercle*'?

It is a spongy mass on one of the genital plates, pierced with numerous holes like a madrepore coral, and is supposed to act as a filter.

17. What is the ambulacral system?

It is the set of tubes and vessels which are connected with the suckers or tube-feet.

18. What is the general arrangement of the ambulacral system?

From the madreporiform tubercle runs a tube to the other side of the body, called the '*sand canal*'; it there enters a '*circular canal*' which surrounds the throat,[2] from which branch five '*radiating canals*,' which run along the ambulacra; and from these are smaller branches to each tube-foot, all containing water.

19. How are the tube-feet drawn in and out?

Each tube-foot has a bulb at its base, supplied with water by the ambulacral system. When

[1] The *Saleniadæ* have more than ten.

[2] There appear to be reservoirs for the water attached to this, called '*Polian vesicles*.'

the bulb contracts, it forces the water into the tube-foot, which is thus pushed out; when the skin of the tube-foot contracts, it forces the water back into the bulb, which draws the tube-foot in after it.

20. Describe the digestive system of the *Echinus*.

The mouth has a complicated set of jaws which leads into a distinct throat, stomach, and intestine; the latter, after winding twice round the body, ends in a distinct anus.

21. Describe the jaws of the *Echinus*.

It is a pyramid on a five-sided base, formed of five triangular pyramids, each of which contains a long curved tooth, all meeting at the top. It is formed of the same substance as the shell, and all its parts are movable.

22. How is it worked?

Round the mouth opening of the test are five shelly arches, from the summits of which run muscles to the tip of the jaw, which by contracting draw it in; and from between them run muscles to the base of the jaw, which by contracting draw it out, and by acting separately these rub the pieces against each other.

23. What is the jaw often called?

'*Aristotle's Lantern*,' because he compared it to a lantern.

24. What is the circulatory system in the *Echinus*?

It consists of a circular tube near the anus; another round the gullet, and a large contractile *heart running* from one to the other.

25. What is the nervous system?

It consists of a circle round the gullet, with branches along the ambulacra, running to the eyes in the apical disc.

26. How do the *Echinoids* breathe?

The sea-water occupies all the inside of the shell not filled by their body, every part of which it therefore continually bathes.

27. What is a young *Echinus* like?

It is compared to a painter's easel. It consists of a dome, with thirteen long calcareous arms, mostly pointing in one direction, and is two-sided.

28. How are the *Echinoids* divided?

Into the centric and excentric.

29. How are these divisions distinguished?

In the centric:

1. The mouth is in the centre of the base, and the anus in the centre of the apical disc.
2. The tubercles are comparatively large.

In the excentric:

1. The mouth or anus or both are excentric in position.
2. The tubercles are comparatively small.

30. What are the *Asteroids*?

The Starfishes.

31. What are their distinguishing characters?

1. Their star-like shape.
2. Having their tube-feet and part of their stomach contained in the arms.

32. What skeleton have they?

Each arm is supported by a series of transverse rings *formed of* several calcareous pieces.

33. What peculiar appendages are often found on them?

Little stems, with movable pincers at the end, called '*Pedicellariæ*.'

34. Have they any proper spines?

Their skin is studded all over with short and irregular tubercles, and immovable spines.

35. In what respects do they agree with the *Echinoids*?

Their ambulacral system, with madreporiform tubercle and tube-feet, is the same; the circulating and nervous systems are similar, and they admit water in the same way for breathing.

36. Which are the ambulacra in the starfish?

The undersides of the rays; the upper sides being the interambulacra.

37. Describe their digestive system?

They have no teeth, but their stomach is large, and two very folded branches of it are contained in each ray. Some have a separate anus, some have not.

38. Where are the eyes of the starfish?

At the ends of its rays.

39. What are the chief familiar varieties of the *Asteroids*?

The Common Starfish, the Sun-star, and the Goose-foot.

40. What are the *Ophiuroids*?

The Brittle Stars and Sand-stars.

41. What the reasons for these names?

They are called *Ophiuroids* because their long arms are like the tails of serpents, and 'brittle' *stars because* they easily break.

42. What parts is an *Ophiuroid* composed of?

1. A central piece.
2. Five long arms.

43. Describe the central piece.

It contains all the viscera of the animal. The mouth is in the centre, and is surrounded with tentacles; it leads into a simple stomach, and there is no anus. The ambulacra radiate from the mouth.

44. Describe the arms.

They are rather simple or branched, and sometimes have short spines; they are formed of four rows of stony pieces on the outside and one row in the centre, and have a tube in their interior.

45. How do the *Ophiuroids* differ from the *Asteroids*?

In having no part of their viscera contained in their arms.

46. Why are the *Crinoids* so called?

From their resemblance to a lily.

47. What is their distinguishing character?

They are attached to the sea bottom by a flexible stalk, either throughout life or in youth only.

48. Of what parts is a *Crinoid* composed?

1. The column.
2. The calyx.
3. The arms.

49. Describe the column.

It is composed of many calcareous joints; it is enlarged at the base, and supports the calyx at the top; *and it sometimes* has short branches.

50. Describe the calyx.

It is like a cup or flower, and is composed of large pieces immovably fixed together; it is roofed over by another set of pieces, forming a shallower cup, which is pierced with openings for the mouth, the anus, and the passage of the eggs: the circumference supports the arms.

51. Describe the arms.

They are very numerous and much branched, with little side fringes, all composed of calcareous joints, and grooved on their upper surface for an ambulacral tube.

52. What two kinds of *Crinoids* are there?

1. Those that are fixed throughout life.
2. Those that are only fixed when young.

53. What is the commonest of the permanently fixed ones?

They are almost all fossil. One found also living is the '*Pentacrinus*,' so called because its joints are five sided.

54. What is the commonest of the temporarily fixed ones?

The *Comatula*, or Feather-star.

55. What are the *Cystoids*?

They are *Palæozoic* fossils, consisting of a box, formed of many-sided calcareous plates, having a short stalk, and sometimes provided with arms.

56. What are the *Blastoids*?

They are Palæozoic fossils, consisting of a box, formed into five ambulacral, and five inter-ambulacral areas; having a short stalk at the base, the mouth in the centre of the top, and no *arms*.

57. What other names have the *Holothuroids*?

Sea-cucumbers and Trepangs.

58. Describe the appearance of the *Holothuria*.

It is like a cucumber in shape. It has a set of feathery tentacles surrounding the mouth, and is covered by suckers, in some scattered irregularly, in others in five rows. It has no hard parts, except some minute spicules in its skin.

59. What is the digestive system?

The intestine is long and twisted, and is generally filled with sand; it ends in a large vessel called the '*cloaca*,' at the other end of the body.

60. What remarkable respiratory system has it?

The so-called '*respiratory tree*,' consisting of two sets of tubes which branch like a tree, and are filled with water admitted through the cloaca.

61. What other kind of *Holothuroid* is there?

The '*Synaptæ*,' which has no suckers, but moves by means of anchor-shaped spicules.

SCOLECIDA.

1. What are the *Scolecida*?

They comprise the *Helminthozoa* and the *Rotifera*.

2. What are the *Helminthozoa*?

They are peculiarly organised worms, many of which are internal parasites.

3. What are the two divisions of the *Helminthozoa*?

The *Platyelmia*, or flat worms; and
The *Nematelmia*, or round worms.

4. What are the orders of the *Platyelmia*?

1. *Tœniadœ*, 2. *Trematoda*, 3. *Turbellaria*; of which the *Turbellaria* are divided into the two sub-orders, *Planarida* and *Nemertida*.

5. How do these differ in habits and appearance?

The *Tœniadœ* are long and parasitic.
The *Trematoda* are short and parasitic.
The *Nemertida* are long and not parasitic.
The *Planarida* are short and not parasitic.

6. What are the *Tœniadœ*?

They are the tape-worms which inhabit the intestines of warm-blooded animals.

7. Of what parts is the *Tape-worm* composed?

It consists of two parts: 1 the head, and 2 the divided body.

8. Describe the head.

It is very small, and is surrounded by hooklets or suckers; there is no mouth or digestive system.

9. Describe the divided body.

Each segment develops eggs; there are a great number of them; they are all flat; the farthest from the head is the oldest, and breaks off when ripe.

10. What is the life-history of the *Tape-worm*?

1. The last joint (*proglottis*) bursts, and the *eggs* escape.

2. The egg is eaten by an animal and develops in its lever or muscles into a 'cystic worm' (*scolex*).
3. The infected animal is eaten by another, and the cystic worm develops in its intestine into a perfect tape-worm (*strobila*).

11. What are the *Trematoda*?

They are known as 'Flukes;' some inhabit the liver, and cause the 'rot' in sheep.

12. Describe a *Fluke*.

It is a short flat worm, with a sucker at one end, where the mouth is. The intestine is branched, and merely hollowed out in the substance of the body, and has no anus.

13. How do the *Turbellaria* differ from the *Tæniadæ* and *Trematoda*?

1. They are non-parasitic.
2. They are provided with cilia.
3. Their heads have no suckers or hooklets.

14. Into what two sections are they divided?

The *Planarida* and the *Nemertida*.

15. Describe a *Planarian*.

They are oval and flat, with their mouth near the centre, armed with a long proboscis; their intestine is branched in some, and has no anus; they are provided with cilia, and often with eyes.

16. Describe the *Nemertida*.

Their structure is like that of the *Planarians*, but they are very long and have an anus. They are called '*Ribbon-worms*.'

17. Where are the *Turbellarians* found?

Some crawling by stones in the sea, and some in fresh water.

18. What are the orders of *Nematelmia*?

The *Acanthocephala*, the *Gordiacea*, the *Nematoda*, and the *Chætognatha*.

19. Describe the *Acanthocephala*.

They have a proboscis armed with hooks, but no mouth or alimentary canal.

20. Describe the *Gordiacea*.

They are like long hairs; they have a mouth and alimentary canal, but no anus.

21. Describe the *Nematoda*.

They are cylindrical, and are called '*Thread-worms*.' They have mouth, alimentary canal and anus.

22. Describe the *Chætognatha*.

They are fish-like animals, non-parasitic, with the mouth armed with bristles, and their skin expanded into fins; they have both intestine and anus.

23. What are the *Rotifera*?

They are microscopic animals, called '*Wheel-animalcules*.'

24. Why are they called '*Rotifera*?'

Because they all have ciliated lobes round their mouth, which they move in such a way as to look like a wheel going round.

25. How do they differ from the *Infusoria*?

1. By the 'wheel' apparatus.
2. By having a distinct intestine and anus.
3. By having a nervous ganglion.
4. By various other structures not found in the Infusoria.

26. What is there remarkable in their digestive system?

They have very complicated jaws, resembling a pair of gridirons situated in their throat.

27. What is their water-vascular system?

It consists of two tubes running up the sides of the body, with little bags opening into them.

28. What is there remarkable in their nervous system?

Their brain is very large in proportion to their size.

29. What organs of sense have they?

An eye and two feelers.

30. Are the males and females alike?

No; the females alone show their full structure.

31. What two kinds of *Rotifera* are there?

The fixed and the free.

32. What characteristic organ do the free forms possess?

A telescopic foot, which ends in a pair of toes used as a forceps, but sometimes in a sucker.

ANNULOSA.

1. Why are the *Annulosa* so called?

Because their bodies are formed of a number of rings.

2. What are their distinguishing characters?

1. Their body is divided into a number of segments, which come one after another in a straight line.

2. Their nervous system consists of a double row of ganglia on the under side of the body.

3. What is another name for them?
'*Homogangliata.*'

4. What does this name allude to?
The uniformity of their nervous system.

5. What is the difference in the position of the nervous system between the *Annulosa* and the *Vertebrata*?
In the *Vertebrata* the nervous system runs down the back, and in the *Annulosa* down the front.

6. What are the two divisions of the *Annulosa*?
1. The *Anthropoda*, whose limbs are jointed.
2. The *Annelida*, whose limbs are not jointed or absent.

7. Into what orders are the *Annelida* divided?
The *Gephyrea*, the *Hirudinea*, *Oligochæta*, *Tubicola*, and the *Errantia*.

8. What sort of animals belong to the *Gephyrea*?
They are worm-like marine animals of a curious shape; some like a spoon, but with their mouth surrounded with tentacles, or produced into a proboscis.

9. Do they certainly belong to the *Annulosa*?
They have long been classed with the *Echinodermata*.

10. How do they agree with the *Echinodermata*?
They are very like some of the *Holothuroids*,

especially in their circle of tentacles, and in their twisted intestines, and in the respiratory trees of some.

11. In what do they agree with the *Annelida*?

1. They have no ambulacral system.
2. They form no spicules.
3. Their body is often ringed.
4. They have a ventral nervous cord, but without ganglia.

12. Why are they called *Gephyrea*?

Because they form, as it were, a bridge between the *Echinodermata* and *Annelida*.

13. Into what two sections may the remaining *Annelida* be divided?

1. The *Branchiata*, which have external breathing organs.
2. The *Abranchiata*, which have not.

14. Which of the orders belong to these divisions?

The *Hirudinea* and *Oligochæta* are abranchiate, and the *Tubicola* and *Errantia* are branchiate.

15. What animals are included in the *Hirudinea*?

The Leeches.

16. By what are the Leeches characterised?

By having a sucker at one or both ends of their body, for locomotion, and being without any of the bristles which the other orders possess.

17. What is their digestive system?

They have a large stomach, from which hang numerous pairs of extra sacs, the first and last pair of which are largest: the intestine is short and straight.

18. How is it adapted to the blood-sucking habits?

1. It is of large capacity.
2. It is united to the skin by a spongy and very elastic tissue.

19. What is their circulatory system?

It consists of four longitudinal vessels, connected by lateral ones.

20. What is their respiratory system?

There are a number of openings, called '*stigmata*,' on the sides, leading into hollow sacs, called, '*segmental organs*,' which probably represent this.

21. What eyes have they?

A series of simple eyes round the head.

22. How is the medicinal leech able to draw blood?

It has three jagged teeth like saws.

23. Why are the *Oligochœta* so called?

Because they have comparatively few bristles.

24. What animals belong to this order?

The Earth-worms and the Water-worms.

25. Where are the bristles of the Earth-worm?

In eight rows on its sides and underneath; they point backwards, and act as levers in helping it forwards.

26. Can an earth-worm be increased by division?

No: if it be cut in two, the front part may live, but the hinder part will die.

27. What is there remarkable about the Water-worms?

They are reproduced in a peculiar way: a bud

grows between two rings, which develops into a perfect animal, and so do the two parts of the original worm, and they then all separate.

28. Why are the *Tubicola* so called?

Because they form hard tubes to live in.

29. What other name have they?

'*Cephalo-branchiata*,' because their breathing organs are situated on their head.

30. Describe their breathing organs.

They consist of two tufts of threads, each fringed with cilia.

31. Which is the commonest of the *Tubicola*?

The *Serpula*, which forms winding tubes attached to stones or shells on the sea shore.

32. Describe the animal which forms these tubes.

It has a worm-like body, with short bristles on the side to enable it to move in the tube. On its head are two tufts of branchiæ and two feelers, one of which is much enlarged and serves as a plug to close the opening of the tube when the animal retires.

33. How does the *Terebella* differ from the *Serpula*?

It forms a covering of pieces of shell and sand, instead of making a tube, and its head has numerous thread-like tentacles.

34. Why are the *Errantia* so called?

Because they are free animals, among the Branchiate division.

35. What other name have they?

'*Dorsibranchiata*,' because their breathing organs are situated along their backs.

36. Describe one of their segments.

It consists of two arches, the dorsal arch and the ventral arch; on the sides are '*foot-tubercles*,' divided into two, each supporting a set of bristles, and a fleshy feeler in the middle, called a '*cirrhus*'; the two tufts of breathing organs branch out on each side of the back.

37. What peculiarities do they present?

1. Their segments are very numerous and similar.
2. Their heads are very distinct, and have often a proboscis or complicated horny jaw.

38. Which is the commonest of them?

The Lob-worm, which burrows in the sand; its branchiæ are in the middle of its body only.

39. Describe the Sea-mouse.

It is short and oval, and has its back covered with a double row of broad scales, which it can raise or lower, by which it admits the water to the delicate skin beneath, and so breathes. Its sides are covered with harpoon-like bristles, with metallic lustre.

ARTHROPODA.

CRUSTACEA.

1. What are the four classes of the *Arthropoda*?

1. *Crustacea*, 2. *Arachnida*, 3. *Myriapoda*, 4. *Insecta*.

2. What are the characters of the *Crustacea*?

1. Their breathing organs are gills.
2. They have two pairs of antennæ.
3. They have more than eight legs or swimming organs.
4. These are carried both on the thorax and abdomen.
5. Their front feet are modified for feeding purposes.
6. They are covered by a hard shell or '*crust*.'

3. What are the segments of a crustacean called?

'*Somites*.'

4. Into what three parts may the body of a typical crustacean be divided?

The head, thorax, and abdomen.

5. How many somites are there in each?

Seven in the head, seven in the thorax, and, including the tail-joint or '*telson*,' seven in the abdomen.

6. Are these divisions and numbers of somites found in all?

No: only in the most perfect.

7. Into what sub-classes are the *Crustacea* divided?

1. *Pectostraca*, 2. *Entomostraca*, 3. *Merostomata*, 4. *Malacostraca*.

8. Why are the *Pectostraca* so called?

Because they are fixed when adult and have shells.

9. Into what two orders are the *Pectostraca* divided?

Cirripedia and *Rhizocephala.*

10. What animals are included in the *Cirripedia*?

The Acorn-shells and Barnacles.

11. Why are they called *Cirripedia*?

Because their feet are formed into (24) curls or '*cirri*,' forming their so-called '*glass-hand.*'

12. What is their young state?

They are locomotive, being provided with swimming-feet and four antennæ.

13. How is their shell formed?

The substance is poured out of the antennæ of the young.

14. Which way are they fixed in their shells?

Head downwards, with their curled feet protruding.

15. What two kinds of Cirripedes are there?

The Sessile and the Pedunculated.*

16. What are the Sessile Cirripedes?

They are the acorn-shells, found covering every rock by the seaside.

17. Describe their shell.

It consists of a flat basis, and a limpet-like shell above it, composed of several pieces immovably fixed. It is open at the top, but is there covered by a movable lid or operculum. Its substance is often porous.

18. What are the Pedunculated Cirripedes?

They are the Barnacles, or Goose-mussels, found attached to floating wood.

* Darwin's subdivisions are Thoracica, Abdominalia, Apoda: *the last two including* some peculiar forms; the first including *all those here mentioned.*

19. What two parts are they composed of?

1. The '*peduncle*' or fleshy stalk, by which they are attached.
2. The '*capitulum*' or head, which is protected by the shell.

20. Describe their shell.

It is oval and flattened, and formed of several pieces which are movable upon each other.

21. What are *Rhizocephala*?

Curious parasitic animals allied to the Cirripedes, so called from having on their heads root-like threads, running into the body of their host.

22. What is the meaning of *Entomostraca*?

Shelled insects, many of them resembling insects encased in shells.

23. What are their distinguishing characters?

1. They are of small size.
2. Their feet are not encased in a covering.
3. Their 'crust' is formed of one or two pieces only, called the '*carapace*.'
4. Their somites are either not clearly marked, or are indefinite in number.

24. What are the orders of *Entomostraca*?

Epizoa, *Ostracoda*, *Copepoda*, *Cladocera* and *Phyllopoda*.

25. Why are the *Epizoa* so called.

Because they are parasitic upon fishes.

26. What is their character when young?

They are locomotive and provided with legs, eyes and antennæ.

27. What is their character when adult?

They become deformed, and adhere by means of suckers on the head, or on their two arms

joined in one, or by hooks; and they develop four large bags, two connected with the stomach and two filled with eggs.

28. Why are the *Ostracoda* so called?

Because their body is completely covered by a double (bivalve) shell.

29. Describe the commonest of them.

This is the '*Cypris*,' its shell is microscopic, and bean-shaped, with a hinge of skin along the back, so that the shells are on its sides: its legs and tail project, and are kept in incessant motion.

30. Why are the *Copepoda* so called?

Because their feet are used to row them through the water, like oars.

31. Describe the commonest of them.

This is the '*Cyclops*,' it has only the upper part of its body covered by a carapace, and has five pairs of legs and a tail. It has a single eye.

32. Why are the *Cladocera* so called?

Because their large pair of antennæ are like long branched horns.

33. Describe the commonest of them.

This is the '*Daphnia*,' or common water-flea. Its shell is composed of two pieces without a hinge, and is placed above and below it. Its head is not contained within the shell; it swims by its branched antennæ, and its breathing organs are attached to its five pairs of legs.

34. Why are the *Phyllopoda* so called?

Because their feet are flat, overlapping and leaf like.

35. Describe the commonest of them?

There are two different kinds: one the *Apus*,

which has a carapace, and two pairs of legs supporting the branchiæ; and another the *Branchipus*, which has no carapace, and fewer legs.

36. What difference is there in the breathing organs of these orders?

In the *Ostracoda* and *Copepoda*, the gills are attached to the appendages of the head.

In the *Cladocera* and *Phyllopoda*, they are attached to the legs.

37. Where are these *Entomostraca* chiefly found?

The greater number of them inhabit fresh water.

38. What are *Trilobites*?

They are Palæozoic fossils, which were nearly allied to the *Phyllopods*, and appear intermediate between them and the *Merostomata*.

39. Why are they so called?

Because their 'crust' was separated longitudinally into three lobes.

40. Describe a *Trilobite*.

It consists of three parts: the head, the thorax, and the tail or '*pygidium*,' each of which was trilobed, and the last two divided into numerous segments. The head had two large compound eyes; they perhaps had numerous feet; they could roll themselves up in a ball.

41. Why are the *Merostomata* so called?

Because the upper end of their legs, or their thighs, are furnished with teeth which are used as jaws.

42. How do they otherwise differ from the *Entomostraca*?

By their large size, and the legs being covered by a 'crust.'

43. What are their two orders?

The *Xiphosura* and the *Eurypteridæ*.

44. Which of these is extinct?

The *Eurypteridæ*.

45. Why are the *Xiphosura* so called?

Because their tail is long and sharp like a sword.

46. What animals form this order?

The Limuli, or King Crabs.

47. Of what parts does the *Limulus* consist?

It is divided into three parts: the cephalic shield, covering the head; the abdominal shield, and the sword-like tail.

48. Describe the head.

It is protected above by a semicircular dome-like shield, which carries two compound and two simple eyes; below, it has six pairs of legs, the first pair bent upwards, each with teeth at their base, and claws at the other end.

49. Describe the abdomen.

It is protected above by a six-sided shield; below it has six pairs of leaf-like appendages, five of which carry branchiæ, and are used for swimming, and the first pair overlaps and protects the rest, and is called the '*operculum*.'

50. Why are the *Eurypteridæ* so called?

From the possession of two broad fin-like organs.

51. How did they differ from the *Limuli*?
1. They were not protected by two shields.
2. Their abdomen had no appendages.
3. Their telson was not long and sword-like.

MALACOSTRACA.

1. Why are the *Malacostraca* so called?
Because the 'crust' they form is softer than the calcareous shells of the *Cirripedia* or *Mollusca*.

2. What are their distinguishing characters?
1. They have never more than seven somites in the head, or thorax, or abdomen.
2. Their successive segments are in general more definitely marked.

3. What are the two divisions of the *Malacostraca*?
The *Edriophthalmata*, and the *Podophthalmata*.

4. What is the meaning of these words?
Sessile-eyed and Stalked-eyed.

5. How are they distinguished?
The *Edriophthalmata* 1. Have their eyes flat on the head. 2. Have no carapace.
The *Podophthalmata* 1. Have their eyes mounted on stalks. 2. Have a carapace.

6. What is a *carapace*?
The large 'crust' formed over the head and thorax.

7. What are the three orders of sessile-eyed *Malacostraca*?
The *Lœmodipoda Amphipoda*, and *Isopoda*.

8. What are the characters of the *Lœmodipoda*?

1. Their abdomen is rudimentary.
2. Their breathing organs are attached to their thoracic legs.
3. Their first thoracic segment is joined to the head.

9. What are the characters of the *Amphipoda*?

1. Their abdomen has the seven segments.
2. Their breathing organs are attached to their thoracic legs.
3. Their first thoracic segment is distinct from the head.

10. What are the characters of the *Isopoda*?

1. Their respiratory organs are attached to the abdomen.
2. The head and thorax are distinct.

11. Why are the *Lœmodipoda* so called?

Because their first pair of feet appear to arise from the throat.

12. Name an example of the order.

The Whale-louse.

13. Why are the *Amphipoda* so called?

Because their legs are used both for swimming and walking.

14. Name an example of the order.

The Sand-hopper.

15. Why are the *Isopoda* so called?

Because their feet are of uniform size.

16. What sections are they divided into?

The Natatorial, the Sedentary, and the Cursorial.

17. Name an example of an Isopod.
The Wood-louse.

18. Which of these three orders are most nearly allied?
The *Læmodipoda* and the *Amphipoda.*

19. What are the two orders of the *Podophthalmata*?
The *Stomapoda* and the *Decapoda.*

20. How are the *Stomapoda* distinguished from the *Decapoda*?
1. There are six or eight pairs of legs.
2. The branchiæ are not enclosed in a cavity.
3. The shell is comparatively thin.

21. Why are they so called?
From their largely developed foot-jaws.

22. What are foot-jaws?
When the legs of a crustacean are modified to serve the office of jaws, they are called '*foot-jaws.*'

23. Describe the commonest of the Stomapods.
This is the '*Squilla mantis.*' It has a very thin shell, and small carapace; its second pair of foot-jaws are large and toothed; its branchiæ are attached to the first five pair of abdominal feet; it has swimming paddles, or '*swimmerets,*' on its abdomen and on the last three joints of the thorax, and has a strong broad tail.

24. Why are the *Decapoda* so called?
Because they have always ten feet.

25. What animals are included in this order?
The Lobsters, Crabs, Shrimps and Hermit-crabs, *&c.*

26. What are the main characters of the *Decapoda*?

1. They have ten legs.
2. Their branchiæ are contained in an internal chamber.
3. Their shell is strong.
4. Their carapace is large.

27. Into what three tribes are the *Decapoda* divided?

1. The *Macrura*, or long-tailed.
2. The *Anomura*, or irregular-tailed.
3. The *Brachyura*, or short-tailed.

28. What are the distinguishing characters of the *Macrura*?

1. Their abdomen is well developed and not covered by the carapace.
2. They have a strong tail or telson, formed for swimming.

29. What common animals are included among the *Macrura*?

Lobsters, Shrimps, Prawns.

30. Describe a separate joint of the Lobster.

It consists of a tube formed of two arches, the '*tergum*' on the top, and the '*sternum*' below, with two diverging pieces at the sides, called '*pleura*;' beneath these are fixed the appendages, i.e. legs or swimmerets.

31. Describe one of the appendages.

It consists of a first joint, called the '*protopodite*'; it then branches into two, called the '*endopodite*' and '*exopodite*,' and has sometimes an extra piece, called the '*epipodite*.'

32. Describe every joint of the Lobster, beginning with the tail.

1. The telson, with no appendages.
2. Simple joint, with broad swimmerets.
3, 4, 5, 6, 7. Do. with narrow and soft swimmerets. These form the abdomen.
8. Joint covered by the carapace, and bearing a leg whose end is pointed.
9 Like 8, but with an epipodite to keep the gills apart.
10, 11. Joints with legs, whose ends are nipping claws.
12. Carries the large claws.
13. Carries a large pair of maxillipedes, or foot-jaws.
14, 15. Carry smaller foot-jaws.
16, 17. Carry the first and second pairs of maxillæ or true jaws.
18. Carries the strong biting jaws or mandibles.
19. Carries the long antennæ.
20. Carries the attenules.
21. Carries the eyes.

33. Describe the digestive system of the Lobster.

The throat leads into a large stomach, containing a grinding apparatus, called the '*lady-in-the lobster*,' and the intestine runs straight to the anal opening underneath the telson.

34. Describe the circulatory system in the Lobster.

The heart is a single muscular bag, situated near the centre of the back; it drives the blood to all parts of the body, leaving it to escape into *the spaces between* the viscera and return to the

heart through a number of shallow sinuses situated along the back: but the blood from the gills is brought back by special veins.

35. Describe the respiratory system of the Lobster?

The gills are pyramidal bodies, attached to the bases of the legs, and enclosed in a special chamber, the water in which is removed by the motion of the legs, and by a special flapper: each gill has a central stalk and branching laminæ on each side.

36. What organs of sense have they?

A pair of compound eyes, two pairs of antennæ, and a pair of ears.

37. What powers of reparation have they?

If they lose a claw or leg, or throw one off in fright, as they sometimes do, the leg or claw grows again from the stump, and, after two or three moults, attains its former size.

38. What is the character of the *Anomura*?

Their abdomen is either soft, or it is formed like a crab's, with a few extra pieces.

39. What animals are included among the *Anomura*?

Hermit Crabs and others which look very much like ordinary crabs.

40. Describe the commonest of them.

This is the Hermit Crab. Its abdomen is soft, and ends in a sucker; one of its great claws is larger than the other; there are a few short feet on its abdomen: it hides in dead shells, which it *carries on its* back.

41. What is the character of the *Brachyura*?

The abdomen is rudimentary, consisting of a few small plates tucked up underneath: the whole upper surface being composed of the carapace.

42. What animals are included in the *Brachyura*?

All common Crabs.

43. What different kinds of Crab are there?

Swimming Crabs, Shore Crabs and Land Crabs.

44. What peculiarity does their nervous system present?

All the ventral ganglia are concentrated into one.

45. Describe the growth of the Crab.

It passes through three stages:

1. It is like a hemisphere, with a spike on the middle; its feet are not properly formed, and it has a long narrow tail, with spikes at the end.
2. Like the adult, but with its abdomen standing out like a lobster's, and having false feet.
3. The perfect animal.

ARACHNIDA.

1. What are the characters of the *Arachnida*?
   1. Their head and thorax is united into one mass, the '*cephalothorax*.'
   2. They have eight legs.
   3. They have no legs on their abdomen.

4. They do not breathe by gills.
5. They have no antennæ.
6. Their eyes are simple and sessile.

2. Of what parts does their mouth consist?
1. A pair of mandibles or lower jaws.
2. A pair of maxillæ or upper jaws, each of which has a pointed appendage, the '*palpi*.'
3. A lower lip, or '*labium*.'

3. What animals do the *Arachnida* include?
The Mites, Scorpions and Spiders.

4. Into what two sections are the *Arachnida* divided?
The *Trachearia* and the *Pulmonaria*.

5. What are the characters of the *Trachearia*?
1. They breathe by the general surface of the body or by '*tracheæ*.'
2. They have not more than four eyes.

6. What are tracheæ?
They are little branching tubes, running through the body, and admitting the air by openings called '*stigmata*' on the under side. They are kept open by a spirally coiled thread.

7. What are the characters of the *Pulmonaria*?
1. They breathe by '*pulmonary sacs*.'
2. They have six or more eyes.

8. What are pulmonary sacs?
They are little sacs in the side of the body opening by stigmata, and containing folds of flesh covered by fine veins.

9. What are the three orders of *Trachearia*?
Podosomata, *Monomerosomata* and *Adelarthrosomata*.

10. What are the *Podosomata*?

They are the Sea Spiders, found crawling about beneath stones.

11. What are their characters?

1. They breathe by the surface of the body.
2. They live in sea-water.
3. Their abdomen is rudimentary.
4. Their legs sometimes contain part of the stomach.

12. Why are they called *Podosomata*?

From the great size of their legs.

13. What is the chief reason of their being classed with *Arachnida*?

Their having four pairs of legs.

14. Why are the *Monomerosomata* so called?

Because their whole body is joined into one piece.

15. What other name have they?

The *Acarina*, or Mites.

16. What peculiar forms are often included in these?

The *Pentastomida*, parasites in the lungs or head, and the *Tardigrada*, or Bear-animalcules.

17. Why are they placed here?

Chiefly from having four pairs of legs at some period of life.

18. Why are the *Adelarthrosomata* so called?

Because the division between the cephalothorax and abdomen is not well marked.

19. What divisions are well marked?

The separate segments of the abdomen.

20. What are the chief kinds?

The Harvest-spiders and Book-scorpions.

21. How are these characterised?

The Harvest-spiders have very long legs.

The Book-scorpions have their palpi converted into claws.

22. What are the two orders of the *Pulmonaria*?

Pedipalpi and *Araneida*.

23. Why are the *Pedipalpi* so called?

Because their palpi rival their feet in size.

24. What are their other characters?

1. They have a jointed abdomen.
2. It is not separated from the cephalothorax.
3. They form no webs.

25. How are they distinguished from the *Adelarthosomata*?

By their breathing organs being pulmonary sacs.

26. What are their chief kinds?

The Scorpions and False Spiders.

27. Describe a Scorpion.

They are amongst the largest of the *Arachnida*. Their mandibles form small claws. Their palpi form large strong claws. Their abdomen is not distinct from their thorax. It has twelve segments, the last six being narrower than the first. Their tail ends in a hooked claw, forming the sting, which is perforated for the poison. They are covered by a hard skin.

28. Why are the False Spiders so called?

Because they look like spiders, but spin no web.

29. Why are the *Araneida* so called?

Because they form webs.

30. What other name have they?

The *Dimerosomata*, because their body is distinctly divided into two parts.

31. What animals do they include?

All the true Spiders.

32. How do they breathe?

Partly by pulmonary sacs and partly by tracheæ.

33. Describe their digestive system.

Their mandibles are hooked poisoned fangs: they have long palpi. Their intestine is simple and straight.

34. What is the chief part of the circulatory system?

They have a long dorsal vessel for their heart.

35. Describe their nervous system.

They have three ganglia: the cephalic, thoracic and small abdominal; the thoracic being the largest.

36. Describe their spinning organs.

They have four or six conical organs, called '*spinnerets*,' under the end of their abdomen, each of which has an opening covered as it were with a sieve, through these the fluid passes from the gland that forms it, and hardens into web; each thread thus consisting of innumerable smaller ones; many of these webs are afterwards covered by a sticky fluid.

37. To what uses are webs put?

1. To catch prey.
2. To form a pathway.
3. To line their dwelling-places.

MYRIAPODA.

1. Why are the *Myriapoda* so called?
Because of their numerous feet.

2. What are their distinctive characteristics?
   1. Their head is distinct, but their thorax and abdomen are alike.
   2. They have an indefinite number of legs.
   3. They have legs on their abdomen.
   4. They have one pair of antennæ.
   5. They breathe by tracheæ.

3. Into what two orders are they divided?
The *Chilopoda*, or Centipedes.
The *Chilognatha*, or Millipedes.

4. What are the characters of the *Chilopoda*?
   1. Their antennæ are formed of more than fourteen joints.
   2. They have one pair of legs to each segment.
   3. They have stigmata on every other segment.
   4. Their segments are fewer.
   5. They have powerful jaws, with poison-fangs.

5. What are the characters of *Chilognatha*?
   1. Their antennæ are formed of seven joints.
   2. They have two pairs of legs to each segment.
   3. They have stigmata on every segment.
   4. Their segments are very numerous.
   5. They have weak jaws, without poison-fangs.

6. How do they differ in their habits?
The *Chilopoda* are carnivorous.
The *Chilognatha* are herbivorous.

7. Are the Centipedes ever dangerous?
Not in this country, but some large tropical ones give a very severe bite.

8. What is the commonest Centipede?
The *Scolopendra*, a long yellow worm, found near the roots of plants.

9. What is the commonest Millipede?
The *Iulus*, a long grey worm, which rolls itself into a ball and lives in damp places.

INSECTA.

1. Why are Insects so called?
Because their bodies are so deeply divided into their three parts.

2. What are their distinguishing characters?
   1. Their head, thorax and abdomen are distinct.
   2. They have six legs.
   3. They have no legs on the abdomen.
   4. They breathe by tracheæ.
   5. They have one pair of antennæ.
   6. They have wings.

3. Describe the head of an insect.
All the segments are united into a single piece, which carries two jointed antennæ, two usually compound eyes, and the parts of the mouth.

4. Describe the thorax.

It consists of three segments, all united together, and called the '*prothorax*,' *mesothorax*,' and '*metathorax*,' each of which carries a pair of legs.

5. Where are the wings fixed?

To the mesothorax and metathorax.

6. Describe the leg of an insect.

It consists of from six to nine joints.

1. The '*coxa*,' attached to the thorax.
2. The '*trochanter*,' a small joint.
3. The '*femur*,' a very large and strong joint.
4. The '*tarsus*,' including all the rest of the legs, and consisting of from two to five joints.

7. How do the legs end?

In suckers or hooks.

8. Describe an insect's wing.

It is a flattened membrane, supported by firm hollow tubes, called '*nervures*.'

9. Describe the abdomen.

It is soft, and the joints, generally nine in number, are freely movable on one another, and it has various appendages at the end.

10. What are the chief kinds of abdominal appendages in Insects?

1. Ovipositors for placing the eggs in a proper position.
2. Stings or pincers.
3. Bristles for leaping with.

11. What are the chief kinds of mouth in *insects?*

1. The masticatory; and 2, the suctorial.

12. Describe the parts of a masticatory mouth.

It consists of:

1. An upper lip, or '*labium*.'
2. A pair of biting saws, or '*mandibles*.'
3. A pair of chewing jaws, or '*maxillæ*,' with '*maxillary palps*.'
4. A lower lip or '*labium*,' with '*labial palps*.'

13. Describe the parts of a suctorial mouth.

In this kind the maxillæ adhere together so as to form a tube, called the '*trunk*' or '*antlia*,' and being themselves hollow form a threefold tube. The labial palps form cushions for the protection of the antlia when coiled up.

14. Are there any other varieties of mouth among Insects?

Many; but these are the main types.

15. In what insect can a biting mouth be best seen?

In a Beetle.

16. In what insect can a sucking mouth be best seen?

In a Butterfly.

17. Describe the alimentary system in Insects.

It consists of:

1. The œsophagus.
2. The crop, which is a folded membranous bag.
3. The gizzard, often containing rows of teeth.
4. The chylific stomach, where digestion takes place.
5. The '*Malphigian tubes*.'
6. The intestine, which greatly varies in *length*.

18 What are the Malphigian tubes?

They are long blind tubes which open into the top of the intestine, and are supposed to act as a liver.

19. Describe the circulatory system in Insects.

There is a long '*dorsal vessel*' in the back, consisting of a number of sacs with valves, which only allow the blood to flow from the tail towards the head, where it escapes and finds its way back into the dorsal vessel, through all the vacant spaces of the body,

20. What is the respiratory system of Insects?

They breathe by tracheæ, which are often much branched.

21. What are the organs of sense in Insects?

The eyes and antennæ.

22. Describe the eyes of Insects.

They are formed of a great number (sometimes thousands) of small eyes, all united into one, each small eye is six-sided and has its own nerve thread. Besides these compound eyes, some have also simple eyes, or ocelli, which doubtless have peculiar powers.

23. Describe the antennæ of Insects?

They are always jointed, but otherwise show an infinite variety of patterns, being branched, knobbed, feathered, fringed, or straight.

24. What is there peculiar about the sexes of Insects?

Amongst the social insects, such as bees and ants, there are a great number of no sex, neither male nor female, which are generally called '*neuters.*'

25. What is there remarkable in the life-history of Insects?

Many undergo a metamorphosis in three stages, called the '*larva*,' '*pupa*' and '*imago*.'

26. Describe the larva stage.

The larva is a maggot or caterpillar; some have suckers on their abdomen, called pro-legs, and some have no legs; they eat voraciously, and at the end of this stage often spin a cocoon.

27. Describe the pupa stage.

In this stage, the insect is quiescent, and is enclosed in a hard case.

28. Describe the imago stage.

The case of the pupa is burst, and the perfect insect emerges, provided with wings.

29. How are Insects divided with respect to this metamorphosis?

Into three sections: the *Ametabola*, which undergo no change: the *Hemimetabola*, which undergo an incomplete change; and the *Holometabola*, which undergo a complete change.

30. How does the incomplete change differ from the complete?

The larva is nearly similar to the imago, but has no wings; the pupa is not quiescent, and has the rudiments only of wings; and the imago has the perfect wings.

31. Into what orders are the *Ametabolic* Insects divided?

Anoplura, Mallophaga, Thysanura.

32. What other name is given to the three orders together?

The Aptera, or those without wings.

33. Why are the *Anoplura* so called?
Because they have no bristles on their tails, as the *Thysanura* have.

34. What are their characters?
1. They are parasitic.
2. They have simple eyes.
3. They have a suctorial mouth.

35. What animals are comprised in this order?
The Lice.

36. Why are the *Mallophaga* so called?
Because they live upon hairs or feathers.

37. How do they differ from the *Anoplura*?
In having biting mouths instead of suctorial.

38. What are they commonly known as?
Bird-lice.

39. Why are the *Thysanura* so called?
Because they have bristles on their tails for leaping.

40. What are they commonly known as?
Spring-tails.

41. Where are they usually found?
Hopping about in moist places.

42. What are they remarkable for?
The beautifully marked scales with which some of them are covered.

43. What are the orders of the *Hemimetabolic* Insects?
Hemiptera, Orthoptera, Neuroptera.

44. What are the characters of the *Hemiptera*?
1. They have a jointed beak-shaped mouth, with four bristles for mandibles.

2. They have four wings.
3. In some the two anterior wings are half covered with '*chitine*'—a substance like horn, but more brittle.

45. Into what two sub-orders are the *Hemiptera* divided?

The *Homoptera* and the *Heteroptera*?

46. What are the characters of the *Homoptera*?

1. Their wings are all alike in structure, but not always equal in size.
2. The mouth is turned backwards, so that the beak appears to arise from the back of the head.

47. What are the characters of the *Heteroptera*?

1. Their anterior wings are more or less covered with chitine.
2. Their beak arises from the front of the head.

48. Name three examples of the *Homoptera*.

The Aphis, the Cochineal Insect, and the Frog-hopper.

[49. Give any particulars about the Aphis.

It is a green fly, infesting plants. It pours out a sweet juice from a tube at the end of its abdomen, of which ants are fond. The insects which hatch from their eggs are females, and bring forth their young alive for several generations, and have no wings; then winged males and females are born, and eggs are laid again; i.e. they are oviparous in the winter and viviparous in the summer.

50. Give any particulars about the Cochineal Insect.

The female is wingless, and affords a fine red dye. It is found upon the cactus in Mexico, by millions.

51. Give any particulars about the Frog-hopper.

It infests plants, and covers itself with froth, known as cuckoo-spit; its hind legs are strong, and it makes tremendous leaps.]

52. Name two examples of the *Heteroptera*.

The Boat-fly and the Bed-bug.

[53. Give any particulars about the Boat-fly.

They swim in the water by means of their long legs, which they use as oars; they carry air for breathing between their wings and back.]

54. What are the characters of the *Orthoptera*?

1. Their posterior wings are folded in radiating lines like a fan.
2. Their anterior wings are covered with chitine.
3. Their mouth is masticatory.

55. What are the covered anterior wings called?

'*Elytra*.'

56. How many kinds of *Orthoptera* are there?

Two: the Jumping and the Running.

57. Mention any familiar insects among the jumping *Orthoptera*.

The Grasshoppers, Crickets and Locusts.

58. How are they enabled to jump?

By the enormous development of the femur of their hind legs.

59. Mention any familiar insects among the running *Orthoptera.*

The Blackbeetle and the Earwig.

[60. What other remarkable insects belong to this section.

The 'Walking Sticks' and 'Leaves,' and the Mantis.

61. Describe the 'Walking Sticks' and 'Leaves.'

The 'Walking stick' is very narrow, and its thorax and abdomen are like joints of a stick, and of a similar colour, so that they look like dead twigs. The 'Walking leaves' have their wing cases spread out and figured like a dead leaf, so as to be easily mistaken for one.

62. Describe the Mantis.

It has an elongated body, and its fore legs are enormous and toothed: it holds them up in walking, as if in supplication, and is therefore called the 'Praying Insect'; but they hold them so in readiness to destroy their prey.]

63. What are the characters of the *Neuroptera*?

1. Their wings are traversed by very numerous nervures.
2. They have masticatory mouths.

64. Mention the most remarkable insects belonging to this order.

The Dragon-flies, May-flies, Ant-lions and Termites.

[65. Give some particulars about the Dragon-fly.

In its larva and pupa stages it is aquatic. The pupa has a pair of pincers attached to its head, called the '*mask.*' The imago has no power of *stinging.*

66. Give some particulars about the Caddis-fly.

The larva forms itself a case by cementing pieces of grass, or shells, or sand together into a cylindrical tube.]

67. Into what separate order are the Caddis-flies often formed?

The *Trichoptera.*

68. Why are they so called?

Because their anterior wings are covered with hair.

69. Why should they be separated?

Because they undergo a nearly complete metamorphosis, and thus in two ways approach the *Lepidoptera.*

[70. Give some particulars about the May-fly.

The larva and pupa live in the water, and the mago lives only for a day, hence they are called *Ephemeridæ.*

71. Give some particulars about the Ant-lions.

The larva digs a pit in the sand near an ants' nest, so that the ants may slip down into their jaws at the bottom; if it appears likely to escape, they can throw a shower of sand upon it, and they also throw the dead bodies of the ants out of their pits.

72. Give some particulars about the Termites.

They are social insects, consisting of males and females, soldiers and workers. There is only one male and female, which have wings for a short time only; the female has a large abdomen, 2,000 times larger than the rest of the body, from *which she* lays 60 eggs a minute. The soldiers *are larger* than the workers, and have armed

heads. They form tall mounds of hardened earth, with many chambers, in the centre one of which the female lies; the only approach is by a subterranean passage.]

73. What are the orders of the *Holometabola*?

Aphaniptera, Diptera, Lepidoptera, Hymenoptera, Strepsiptera, Coleoptera.

74. What are the characters of the *Aphaniptera*?

1. Their wings are not manifest, consisting only of little plates on the thorax.
2. Their mouth is suctorial.

75. What insects does this order comprise?

The Fleas only.

76. What are the Fleas remarkable for?

First, for their knife-like jaws; and second, for their enormous jumps—200 times their own length.

77. What are the characters of the *Diptera*?

1. They have but two wings, the hind pair being represented by two knobbed filaments, called '*halteres*.'
2. Their mouth is suctorial and of peculiar form.

78. What is the structure of their mouth?

Their lower lip is formed of a fleshy proboscis, grooved on its upper side, and their mandibles are in the form of pricking bristles.

79. Name some examples of the order.

The House-fly, the Gnat, Hessian-fly, Crane-fly.

[80. Give some particulars about the Gnat.

They lay their eggs in floats on the water. *The larva* and pupa are aquatic, breathing by

tracheæ at the end of tubes running out of their body to the surface.

81. What is the Hessian-fly?

Its larva feeds on the flower of wheat, destroying it entirely.]

82. What are the characters of the *Lepidoptera*?

1. Their wings are covered with scales.
2. They have a suctorial mouth, consisting of a spiral trunk or antlia.

83. What insects are comprised in this order?

The Moths and Butterflies.

84. How are moths distinguished from butterflies?

1. By not having knobbed antennæ.
2. By having the wings flat and not erect in repose.
3. By flying in the dusk or by night, and not in the day.

85. What are the characters of the *Hymenoptera*?

1. Their wings are membranous, with few nervures.
2. They have often both suctorial and masticatory mouths combined.
3. Their abdomen possesses an ovipositor.

86. Name some examples of the order.

Bees, Wasps, Ants, Ichneumons, Sawflies and Gall-flies.

87. Give some particulars about Bees.

They are social insects, and are of three kinds, *queen,* drones and workers. Each hive has one *queen, and the* workers make the cells and feed

the larvæ; the drones are killed when the breeding season is past.

88. Give some particulars about Wasps.

They build nests like the bees, but lay up no honey. All are killed by the winter, except young females, which commence laying eggs in the spring.

89. Give some particulars about Ants.

They are of three kinds, males, females and neuters: they have two peculiar habits.

1. They milk the aphides.
2. They capture other ants and make use of them as slaves.

90. Give some particulars about the Ichneumons?

They have very long ovipositors, and lay their eggs in the bodies of other insects.

91. What are the characters of the *Strepsiptera*?

1. The males have a pair of twisted organs, instead of anterior wings.
2. The females are wingless and footless parasites.

92. Where are they found?

The females lie between the abdominal joints of bees.

93. What are the characters of the *Coleoptera*?

1. Their anterior wings are chitinous, forming elytra.
2. Their mouth is masticatory.

94. What insects are comprised in this order?

The Beetles.

MOLLUSCA.

1. Why are the *Mollusca* so called?
Because the interior of their bodies is soft.

2. What is their distinguishing character?
Their nervous system consists of two or three ganglia, situated irregularly in their body.

3. What are they sometimes called on this account?
'*Heterogangliata.*'

4. Into what two divisions are they formed?
The *Molluscoida* and *Mollusca Proper.*

5. How are these distinguished?
   1. The *Mollusca Proper* have three nervous ganglia, and a two-chambered heart.
   2. The *Molluscoida* have one nervous ganglion, and an imperfect heart.

6. Into what classes are the *Molluscoida* divided?
Polyzoa, Tunicata, Brachiopoda.

7. Why are the *Polyzoa* so called?
Because they are all composite animals, living together in great numbers.

8. What is the general appearance of a colony of them?
They either look like flattened sea-weeds, or little branched twigs, or form a matted covering on stones or shells.

9. What is the skeleton of the colony called?
The 'Polyzoarium.'

10. Where do the separate animals live?

In little cells on the surface of the po zoarium.

11. Describe one of the single animals.

Its alimentary canal goes to the bottom of t cell, and is then bent up again, so that the mou and anus are near each other, and the nerv ganglion is between them. The mouth is s rounded by ciliated tentacles, and can be dra in and out. It has no heart, and the reproduct organs are internal.

12. What other class of animals do the *Poly* resemble?

The *Hydroida.*

13. State the distinctions between them.

IN THE POLYZOA.	IN THE HYDROIDA.
1. The alimentary canal does not open into the body.	It does.
2. There is a nervous ganglion.	There is none.
3. The animals generally communicate by a skin passing over the *outside.*	They communicate an opening in bottom of the cell
4. The alimentary regions do not communicate.	They do.
5. The polyzoarium is sometimes calcareous.	The polypary never i

14. What appendages are found attached to the polyzoarium.

'*Avicularia*' and '*vibracula*.'

15. What are the avicularia?

They are little processes like the head of a bird, having the lower jaw movable.

16. What are the vibracula?

They are like the avicularia, but with a long bristle instead of a lower jaw.

17. What are the orders of the *Polyzoa*?

The *Phylactolæmata* and the *Gymnolæmata*.

18. How are they distinguished?

The *Phylactolæmata* have their tentacles on two arms like a horseshoe, and a lip, or epistome, to cover the mouth.

The *Gymnolæmata* have their tentacles in a circle, and have no epistome.

19. What is the difference of their habits?

The *Phylactolæmata* are mostly freshwater animals, and the *Gymnolæmata* marine.

20. What do their names refer to?

The presence or absence of the lip.

TUNICATA.

1. Why are the *Tunicata* so called?

Because they have a leathery tunic to cover them, instead of a shell.

2. What other name have they?

Ascidians.

3. Why are they called *Ascidians*?

Because the simplest of them looks like a two-necked leather bottle.

4. What is their tunic lined by?

A second coat, called the '*mantle*.'

5. Describe their alimentary system.

The mouth is surrounded by a row of simple tentacles; it leads into a larger chamber, called the '*branchial sac*:' at the bottom of this the throat leads up to a large stomach, the intestine bends up again with a twist, and ends in a large chamber, called the '*cloaca*,' which opens to the outside by the second aperture near the mouth.

6. What is their respiratory system?

It consists of their large branchial sac, which is a membrane with numerous veins, crossing one another at right angles, and covered by cilia.

7. What is their circulatory system?

They have a simple tube for their heart, open at both ends, and without valve, so that the blood flows first one way and then the other.

8. What is their nervous system?

They have a single ganglion between the two openings.

9. What is there remarkable in their habits?

If irritated they squirt out all the water in their branchial sac with great force.

10. What are the three chief kinds of *Ascidians*?

The Solitary, the Social, and the Compound.

11. What are the Solitary Ascidians?

They are simple animals, attached to sea-weed, stones, or shells.

12. What are the Social Ascidians?

They are like a number of solitary ones joined together by a common stalk.

13. What are the Compound Ascidians?

They are imbedded in one gelatinous mass, with their openings sometimes near together, sometimes on opposite sides of the mass.

14. What is there remarkable about the reproduction of any of the Ascidians?

The *Salpa* is a solitary animal, but it produces by budding a chain of different looking *Salpœ*, each of which produces a solitary *Salpa* from an egg.

BRACHIOPODA.

1. Why are the *Brachiopoda* so called?

Because they have two long ciliated arms, but these are not used for locomotion.

2. What other name have they?

Palliobranchiata.

3. Why are they so called?

Because their skin, or mantle, is used for breathing purposes.

4. What are their chief characteristics?

1. They have two long ciliated arms.
2. They form peculiar bivalve shells.

5. How do the shells of a Brachiopod differ from any other bivalve?

1. They are symmetrical, one half of each *being* exactly like the other.

2. They are inequivalve, one being larger than the other.
3. They are situated on the back and front of the animal, instead of on each side.
4. They have a peculiar microscopic structure.

6. What are the two valves respectively called?

The larger is called the ventral valve and the smaller the dorsal valve.

7. Describe the ordinary structure of the ventral valve.

One end is produced into a 'beak,' which usually is pierced by an opening, called the '*foramen*,' and possesses side teeth to lock it to the dorsal valve.

8. What is the purpose of the foramen?

For the passage of a muscular stalk, called the '*pedicle*,' by which the animal attaches itself to the sea bottom.

9. Describe the ordinary structure of the dorsal valve.

It contains in its interior a shelly loop, on which the arms are supported, which in some is very complicated.

10. What is the microscopic structure of a Brachiopodous shell?

It consists of numerous narrow prisms, ranged from inside to outside, and little tubes passing between some of them, into which little folds of the mantle find their way.

11. Describe the interior.

It is divided into two parts, by a membrane; the part near the beak contains the muscles and viscera, and the other part contains the arms.

12. What is their general organisation?

They show considerable likeness to the individual polypes of the Polyzoa, but have a well formed heart, and some have more than one nervous ganglion.

13. What peculiar system do they possess?

The '*atrial system*,' which consists of a series of connected chambers communicating with the exterior.

14. How are the arms formed?

They are lobes on the side of the mouth, covered with '*cirri*.'

15. Into what two orders are the *Brachiopoda* divided?

The *Articulata* and *Inarticulata*.

16. How are these distinguished?

The *Inarticulata* have no hinge-teeth or beak in the ventral valve, nor loop in the dorsal, as the *Articulata* have but they have an anal opening, and the *Articulata* have none.

17. Mention some chief kinds of the *Articulata*.

The *Terebratula*, *Rhynchonella* and *Spirifera*.

18. Give any particulars about these.

The *Terebratula* is the type of the *Brachiopoda*.

The *Rhynchonella* has no tubes in its shell.

The *Spirifera* has long spiral arms.

19. Mention some of the chief *Inarticulate kinds*.

The Crania and *Lingula*.

20. Give any particulars about these.

The *Crania* has one valve attached by its outside.

The *Lingula* has horny gaping shells, with a long pedicle.

MOLLUSCA PROPER.

1. What are the distinguishing characters of the *Mollusca Proper*?

1. They have three nervous ganglia.
2. They have a two-chambered heart.

2. What are the three nervous ganglia respectively for?

The first is for the head.

The second is for the foot.

The third for the general viscera of the body.

3. What are the two chambers of the heart called?

The '*auricle*' and the '*ventricle*.'

4. What do these names refer to?

The auricle is so called because in higher animals it is soft and fleshy, and looks something like an ear.

The ventricle is very strong and muscular, and is so called from its bulging shape.

5. How do they respectively act?

The auricle acts as a reservoir to supply blood to the ventricle, which acts as a pump to drive the blood through the body or to the breathing apparatus.

6. Into what two sections are the *Mollusca Proper* divided?

The *Acephala*, or headless Mollusc, and the *Encephala*, or those with a head.

7. What class forms the section *Acephala*?
The *Lamellibranchiata*.

8. Why are the *Lamellibranchiata* so called?
Because their breathing organs are lamellar, i.e. like the leaves of a book.

9. What other name have they?
The *Conchifera*, from their forming a bivalve shell.

10. What animals are comprised in this class?
Oysters, Mussels, Cockles, &c.

11. What is the position of the valves of the shell with respect to the animal?
They are on each side of it.

12. What are they respectively called?
The right and left valves.

13. What is the apex of each valve called?
The '*umbo*' or '*beak*.'

14. Which way does it turn?
Almost always towards that side where the mouth of the animal is.

15. What are the different parts of the shell called?

1. The side where the beaks are is the '*dorsal side*.'
2. The side opposite to this is the '*ventral side*.'
3. The side on which the mouth is, and to which the beaks usually turn, is the '*anterior*.'
4. The other side is the '*posterior*.'

16. What is the apparatus for opening and closing the valves?

1. They are united along a '*hinge-line*,' which usually has hinge-teeth.
2. They are joined behind the beaks by an '*external ligament*.'
3. Between the hinge-lines lies an elastic '*cartilage*' in pits.
4. Strong muscles go from one shell to the other, called the '*adductor muscles*.'

17. How do these act?

The hinge-teeth keep the shells in their proper place.

The ligament is stretched, and the cartilage is compressed when the shell is closed, so that they both tend to open it.

The adductor muscles alone keep it closed.

18. What lines the interior of the shell?

The '*mantle*,' or '*pallium*,' which also secretes it.

19. What is there remarkable about the digestive system?

The intestine passes through the heart, and the anus is near the respiratory apparatus.

20. What is the respiratory apparatus?

It consists of two gills, formed of plates, and covered with vibrating cilia.

21. In what are the gills sometimes contained?

In some the mantle forms a closed chamber, into which the water is admitted by an inhalent aperture, and let out by an exhalent aperture.

22. What structures do these apertures sometimes form?

Long tubes, called '*siphons*,' which can be drawn in and out in some, but not in others.

23. What other uses have the siphons?

The inhalent siphons bring food to the mouth, and the exhalent carry away the refuse.

24. What is the '*foot*'?

It is a long fleshy organ, which can be put out beyond the shell?

25. What are its uses?

In some it is used for locomotion.

In some it spins a silky '*byssus*,' or rope, to anchor them to the bottom.

In some it helps to bore into wood or stone.

26. What. impressions are left upon the shell by the soft parts of the body?

1. The muscular impressions by the adductor muscles.
2. The pedal impressions by the foot.
3. The pallial impressions by the edge of the mantle.
4. The siphonal impressions by the retractor muscles of the siphons.

27. What differences are there in the muscular impressions?

Some shells have two at the sides, and some have one in the middle, according as they have two adductor muscles or one.

28. What different names are given to the shells on this account?

Those that have one adductor muscle are called *Monomyaria.*

Those that have two are called Dimyaria.

29. What differences are there in the pallial and siphonal impressions?

In some the siphonal impressions are absent, and then the pallial line is simple.

In some the siphonal impression is present, when it forms a bend in the pallial line.

30. What different names are given to the shells on this account?

Those whose pallial line is simple are called *Integropallialia.*

Those whose pallial line is indented by the siphonal impression are called *Sinupallialia.*

31. Into what divisions are the *Lamellibranchs* formed?

1. *Asiphonida,* which have no respiratory siphons.
2. *Siphonida,* which have.

32. Into what two subdivisions are the *Siphonida* formed?

1. The *Integropallialia,* whose siphons are not retractile.
2. The *Sinupallialia,* whose siphons are retractile.

33. Mention some common shells belonging to the *Asiphonida.*

The Oyster, Pearl Oyster and Mussel.

34. Mention some common shells belonging to the *Siphonida.*

The Cockle, Razor Shell and Ship-worm.

ENCEPHALA.

1. What are the common characters of the *Encephala*?

1. They have a distinct head.
2. They have a long tooth-bearing tongue, called an '*odontophore*.'

2. Into what classes are the *Encephala* divided?

The *Gasteropoda*, *Pteropoda* and *Cephalopoda*.

3. Why are the *Gasteropoda* so called?

Because the broad fleshy foot by which they move is attached to the ventral surface of the body.

4. What animals are comprised in this class?

Whelks, Limpets, Snails and Slugs.

5. What is the character of their shell?

They form a single shell; which in a few is divided into several small segments.

6. What names are given to these kinds?

When it is in one piece, it is called '*univalve*'; when divided into several, '*multivalve*.'

7. What is the form of a univalve Gasteropod shell?

It is like a cone more or less twisted into a spiral.

8. Which way is the spiral twisted?

Sometimes the twist is '*dextral*,' when the opening is on the right.

Sometimes '*sinistral*,' when the opening is on the left.

9. What different names are given to the different shapes?

They are called:

'*Discoidal*,' when they are twisted in one plane.

'*Turreted*,' when the spire is long and pointed.

'*Trochoid*,' when the spire is angular and flat at the base.

'*Turbinated*,' when it is rounded.

'*Conical*,' like a limpet shell.

10. State the names which are given to the different parts of the shell.

The apex or tip is called the '*nucleus*.'

The different turns are the '*whorls*.'

The last turn is the '*body-whorl*.'

The line between the whorls is the '*suture*.'

The opening of the last whorl is the '*aperture*.'

All the whorls above the body-whorl together form the '*spire*.'

Periodical ridges, or rows of spines crossing the whorls, are called '*varices*.'

11. What two kinds of shell are there with respect to the central axis about which the whorls turn?

The '*Perforate*' and '*Imperforate*.'

12. Explain the differences between these two.

In the perforate the inner sides of the whorls do not touch, but leave a hole up the centre, called the '*umbilicus*.'

In the imperforate, the inner sides touch and form a solid axis, called the '*columella*.'

13. What differences are there with respect to the aperture?

Some have it '*entire*,' and some '*notched*.'

14. How do some protect the opening of their shell?

By a shelly or horny plate, called the '*operculum*,' situated on the hinder part of the foot.

15. Describe the tongue of the *Gasteropods*.

It consists of a long strap, covered with three bands of teeth, one central, and two lateral; the two lateral ones being composed of one or more rows: it acts like a chain-saw over a cartilaginous cushion.

16. What is the heart of the *Gasteropods*?

It is composed of a single auricle and a ventricle.

17. What organs of sense have they?

Two eyes, two tentacles and two internal ears.

18. What is the embryo *Gasteropod* like?

It always has a shell; and in some, swims by two ciliated lobes coming from the side of the head.

19. How are the *Gasteropoda* divided?

By means of their breathing organs into the *Branchifera*, or water-breathers, and the *Pulmonifera*, or air-breathers.

20. What differences are there in the habits of these two divisions?

The *Branchifera* mostly inhabit the sea.

The *Pulmonifera* inhabit the land or fresh-water.

21. What are the characters of the *Branchifera*?

1. They breathe by means of gills.

[2. The flexure of the intestine is hæmal.]

22. Into what three orders are they divided?

The *Prosobranchiata*, the *Opisthobranchiata*, and the *Nucleobranchiata*.

23. Which of these three are most similar in their habits?

The first two, which both crawl at the bottom of the sea.

24. How are they distinguished?

The *Prosobranchiata*:

1. The gills are contained in a chamber formed by the mantle.
2. They lie towards the front of the body.
3. Their shells are strong.

The *Opisthobranchiata*:

1. Have their gills external.
2. They lie towards the back of the body.
3. Their shells are weak or absent.

25. What are the two divisions of the *Prosobranchiata*?

The *Siphonostomata*, whose shell have a notch for the siphon.

The *Holostomata*, whose shell has the mouth entire.

26. What are the differences in their habits?

The *Siphonostomata* are carnivorous, often boring holes in bivalves by their tongues.

The *Holostomata* are vegetable feeders.

27. Mention any common examples of the *Siphonostomata*.

Whelks and Cowries.

28. Mention any common examples of the *Holostomata*.

Periwinkles and Limpets.

29. What are the two divisions of the *Opisthobranchiata*?

The *Tectibranchiata*, which have shells.

The *Nudibranchiata*, which have none.

30. Mention some examples of this order.

The Bubble Shells and Sea Slugs.

31. What is another name for the *Nudibranchiata*?

The *Heteropoda*.

32. Why are they so called?

Because their habits are different from those of all other *Gasteropoda*.

33. What are their habits?

They swim freely on the surface of the ocean, by means of a flattened fin either on the tail or below the body.

34. What is the character of their shell?

It is fine, glassy, and discoidal.

35. What are the characters of the *Pulmonifera*?

1. They breathe air in a pulmonary chamber.

[2. The flexure of the intestine is at first neural.]

36. How do their shells differ from those of the *Branchifera*?

They are more horny and generally softer.

37. Into what two sections are they divided?

The *Inoperculata*, which have no operculum, and the *Operculata*, which have one.

38. Mention any examples of the *Inoperculata*.

The Snails, Slugs and Pond Snails.

39. Mention any of the *Operculata.*
The Cyclostoma.

40. Why are the *Pteropoda* so called?
Because they move by two wing-like appendages attached to the sides of their head.

41. Where are they found?
They swim in immense numbers on the surface of the ocean.

42. What do they resemble in their organisation?
The *Gasteropoda* in their embryo stage.

43. Into what two divisions are they formed?
Those which have shells (*thecosomata*) and those which have none (*gymnosomata*).

44. What kind of shell have they?
It is very thin and glassy, and often of very curious shape.

CEPHALOPODA.

1. Why are the *Cephalopoda* so called?
Because their head is surrounded by a circle of long arms, which often help in locomotion.

2. What animals belong to this class?
The Cuttle-fishes, Nautilus and Argonaut.

3. What is their digestive system?
They have strong mandibles like the beak of a parrot, and a long odontophore, and a stomach, and the intestine opens into the base of a tube, called the '*funnel*,' opening outside.

4. What is their respiratory system?
They have two or four plume-like gills, con-

tained in a chamber, formed by the mantle which opens into the base of the funnel.

5. What peculiar organ do some possess?

The ink-bag, which secretes a dark fluid, called '*sepia*,' which they expel through the funnel, so as to help them to escape from danger.

6. How do they move?

They either crawl on the bottom of the sea, head downwards, by means of their arms; or swim, by forcing water through their funnel which drives them backwards.

7. What is there peculiar about their nervous system?

It is very concentrated, and the ganglion of the head is protected by a cartilaginous case like a skull.

8. What organs of sense have they?

They have large eyes, and well developed internal ears, and the power of smelling

9. What are their habits?

They are all carnivorous.

10. What are the two orders of the *Cephalopoda*?

The *Dibranchiata* and the *Tetrabranchiata*.

11. What are the characters of the *Dibranchiata*?

1. They have two gills.
2. They have eight or ten arms.
3. Their arms are provided with suckers.
4. They have an ink-bag.
5. Their funnel is a complete tube.
6. Their shell is internal, or if external, without chambers.

12. Into what two sections are they divided?
The *Octopoda* and *Decapoda.*

13. What are their characters?
The *Octopoda* have only eight arms.
The *Decapoda* have eight, with the addition of two longer ones, club shaped at the end: and the body is provided with lateral fins.

14. What are the two chief kinds of *Octapod*?
The *Poulpe* and the *Argonaut.*

15. Describe the *Poulpe.*
It is of large size, rather globular in shape, without any proper internal shell, spotted with various colours, with two very large eyes, and eight long arms connected by a skin at the base.

16. Describe the *Argonaut.*
It has a thin paper-like ridged shell, with no internal divisions, which is discoidal like the Nautilus, after which it is called the *Paper Nautilus*: six of its arms are narrow and two are broad, the latter it spreads over the sides of its shell. The male is different, and is small, and has no shell.

17. How does the *Argonaut* move?
Either by crawling on the bottom on its suckers, or by expelling water from its funnel while the broad arms embrace the shell, and *not* by spreading these out like sails.

18. What are the chief kinds of *Decapods*?
The *Teuthidæ*, or Squids; the *Sepiadæ*, or Cuttle-fishes; the *Spirulidæ*, and the *Belemnites.*

19. Which of these are extinct?
The Belemnites.

20. How are the first three distinguished?

The Squids have a long body, and long internal shell, called the '*pen*.'

The Cuttle-fish has a short body, and broad internal shell, called the '*cuttle-bone*.'

The Spirula has a discoidal shell, divided into partitions, which are united by a tube, called the '*siphuncle*.'

21. Describe the body of a Cuttle-fish.

It is partially divided into two parts: the body and the head. The head contains the mouth in the centre; eight or ten long arms round it; and two eyes on the side. The body contains the viscera and the cuttle-bone; and the funnel comes out between the divisions.

22. Describe one of the arms of a Cuttle-fish.

It is covered with numerous powerful suckers, and in some has also hooks.

23. How are the suckers formed?

They consist of a cup-shaped cavity, with muscular fibres, converging to a prominence in the centre—which, being withdrawn by their contraction, forms a vacuum.

24. What parts of the *Belemnite* are commonly found?

1. The end of the shell forming a solid elongated cone, called the '*guard*.'
2. A strait chambered shell, in structure like the spirula, called the '*phragmocone*,' contained in a hollow cone at the top of the guard, called the '*alveolus*.'

25. What other parts of the *Belemnite* have been found?

Impressions of its body with the lateral fins,

its eight arms with hooks, its two longer arms, and its ink-bag.

26. What are the characters of the *Tetrabranchiata*?

1. They have four gills.
2. They have numerous arms.
3. Their arms are simple, without suckers.
4. They have no ink-bag.
5. Their funnel is not a complete tube.
6. Their shell is external.
7. It is divided into chambers, which are joined by a tube.
8. The last chamber is inhabited by the animal.

27. What are the names of the different parts of the shell?

The plates between the chambers are the '*septa*.'

The lines these form on the surface are the '*sutures*.'

The common tube is called the '*siphuncle*.'

28. What are the two families of the *Tetrabranchiata*?

The *Nautilidæ* and *Ammonitidæ*.

29. Which of these are now living?

The Nautilus itself is the only one hitherto found alive.

30. How are these families distinguished?

In the *Nautilidæ*:

1. The siphuncle is on the inside or in the centre.
2. The sutures are simple.

In the *Ammonitidæ*:

1. The siphuncle is on the outside.
2. The sutures are complicated.

31. What different shapes are there among the *Ammonitidæ*?

They are straight, or spiral, or discoidal.

VERTEBRATA.

1. What are the distinctive characters of the *Vertebrata*?

1. The body has an internal skeleton, divided into joints.
2. It consists of two tubes, one containing a nervous cord; the other, the viscera.
3. The limbs are not more than four.
4. These turn away from the nervous ganglia.
5. They have an 'absorbent' system, consisting of '*lacteal*' and '*lymphatic*' tubes, the former of which collects nutriment from the intestines and pours it into the veins.

2. What are the joints of the back bone called?

'*Vertebræ*.'

3. Name the chief parts of which a typical *Vertebra* is composed.

1. A central piece, called the '*centrum*.'
2. Two upper pieces, called the '*neurapophyses*.'

3. One spinous piece joining these, the '*neural spine.*'
4. Two cross pieces to join two vertebræ together, the '*zygapophyses.*'
5. Two side pieces, called '*transverse processes.*'
6. Two pieces attached to these, called the ribs or '*pleurapophyses.*'
7. Two lower pieces, the '*hæmapophyses.*'
8. One piece joining these, the '*hæmal spine.*'

4. What two arches do these parts form?

1. The '*neural arch,*' containing the nervous cord above; and
2. The '*hæmal arch,*' containing blood vessels, &c. below.

5. Which of these two is always formed?

The neural arch: the hæmal being often incomplete, and forming the second tube of the body.

6. Where is the typical vertebra best seen?

In the tail of a fish, or in the chest of a mammal.

7. Into what regions is the vertebral column divided in the most perfect?

1. The '*cervical*' region, or neck.
2. The '*dorsal*' region, which develops ribs, constituting the chest, and to which the fore limbs are attached.
3. The '*lumbar*' regions, or loins, where there are no ribs.
4. The '*sacral*' region, where several vertebræ grow together into one bone, for the support of the hind limbs.

5. The '*caudal*' region, or tail, where the vertebræ gradually reduce to the centrum only.

8. What are the names of the arches to which the limbs are attached?

The '*pectoral*' or '*scapular arch*,' for the fore limbs, and the '*pelvic arch*' for the hind limbs.

9. Of what bones is each side of the pectoral arch formed?

The '*scapula*,' or shoulder blade;
The '*coracoid*,' attached to it; and
The '*clavicle*,' or collar bone.

10. Give the names of the chie bones of the fore limbs.

1. The '*humerus*,' corresponding to our upper arms.
2. The '*radius*' and '*ulna*,' corresponding to the two bones of our fore arm, the radius being usually the larger.
3. The '*carpal*' bones, corresponding to our wrist.
4. The '*metacarpal*' bones, corresponding to the bones supporting our palms.
5. The '*phalanges*,' corresponding to our fingers.

11. What bones form each side of the pelvic arch?

The '*ilium*,' the '*ischium*,' and the '*pubes*,' which are often joined together into one, called the '*innominate*' bone.

12. What are the names of the bones of the *hind* limb?

1. The '*femur*,' or thigh bone.

2. The '*tibia*' and '*fibula*,' or bones of the lower legs; the tibia being the largest.
3. The '*tarsal*' bones, forming the ankle.
4. The '*metatarsal*' bones, forming the instep.
5. The '*phalanges*,' or toe-bones.

13. To what parts of the vertebral column are these arches attached?

The pectoral arch is attached to the outside of the ribs; the pelvic arch to the '*sacrum*.'

14. What is the general character of the alimentary canal?

It consists of the œsophagus, stomach, small intestine, and large intestine.

15. What different fluids act upon the food?

1. The '*saliva*,' secreted by salivary glands in the mouth.
2. The '*gastric juice*,' secreted by the stomach.
3. The '*bile*,' by the liver.
4. The '*pancreatic juice*,' by the pancreas.
5. The '*intestinal juice*,' by the intestine.

16. What names are given to the food in its digestion?

When it leaves the stomach it is called '*chyme*,' and after passing through the small intestine it is a milky fluid, called '*chyle*,' in which state it is taken up by the lacteal vessels.

17. What is the nature of the blood?

It consists of an infinite number of minute round bodies, called '*corpuscles*,' to which the colour is due, floating in a transparent fluid called the '*serum*.'

18. Into what classes are the *Vertebrata* divided?

Fishes, Amphibia, Reptiles, Birds, and *Mammals.*

19. What larger divisions are proposed?

1st. *Branchiata,* or breathers by gills, including Fishes and Amphibia; and
Abranchiata, including the rest.

2nd. Cold-blooded, including the Fishes, Amphibia and Reptiles; and
Hot-blooded, including the rest.

3rd. *Ichthyopsida,* or fish-like, including Fishes and Amphibia.
Sauropsida, or reptile-like, including Reptiles and Birds; and
Mammalia.

FISHES.

1. What are the chief characters of Fishes?

1. They always breathe by gills.
2. Their blood is cold.
3. Their heart consists of one auricle and one ventricle.
4. Their limbs are in the form of fins.
5. They have '*median*' fins, supported by bony rays.

2. What different kinds of scales have they?

'*Cycloid,*' '*ctenoid,*' '*ganoid,*' '*placoid.*'

3. What are cycloid scales?

They are formed by numerous concentric circu*lar or elliptical* plates.

4. What are ctenoid scales?

They are similar to cycloid scales, but have one side toothed like a comb.

5. What are ganoid scales?

They consist of bone, and are covered by a shining substance, called '*ganoine*'; they are much larger and stronger than other scales.

6. What are placoid scales?

They are detached bony grains or plates, which are sometimes armed with spines.

7. What two kinds of skeleton are distinguished by different names?

The '*exo-skeleton*,' consisting of the scales.

The '*endo-skeleton*,' consisting of the bones.

8. What two different kinds of fish are there with respect to the endo-skeleton?

The cartilaginous and the bony.

9. What is the character of a fish's vertebra?

It is concave on both sides.

10. Into how many regions can the vertebral column be divided?

The '*abdominal*' and '*caudal*.'

11. What is the character of the ribs?

They are imbedded in the muscles, and often give off a branch.

12. What is the character of the skull?

The bones which form it are exceedingly numerous, each bone of the higher Vertebrates being separated into several pieces.

13. Mention some that are peculiar to Fishes.

The '*opercular*' bones, and the '*branchiostegal rays*.'

14. What are the opercular bones?

They form the gill covers.

15. What are the branchiostegal rays?

They are attached to a set of bones below the mouth, called the '*hyoid*' bones, and support a skin which protects the gills below.

16. How are the limbs of Fishes represented?

By two pairs of side fins, called, the '*pectoral*' and '*ventral*' fins.

17. Can the several bones, which generally form the limbs in other animals be traced?

They are generally much modified, and those nearer the extremities increased in number.

18. What other kinds of fin have fishes?

Median fins, called '*dorsal*,' '*anal*,' or '*caudal*' fins.

19. By what two kinds of '*rays*' are the fins supported?

Soft and spinous rays.

20. How do these differ?

The soft rays are numerous and jointed.

The spinous rays are few and in one piece.

21. How are the rays joined to the body?

They are hinged to a number of bones, called '*interspinous*' bones, which are imbedded between the muscles.

22. What two kinds of tail are there?

'*Homocercal*' and '*heterocercal*.'

23. How are they distinguished?

In the homocercal the two halves of the tail *are alike;* in the heterocercal the vertebral *column is* continued into the upper half.

24. What is the general process of respiration in Fishes?

They breathe by leaf-like gills, supported on bones, called '*branchial arches*,' in a special chamber, into which water is admitted from the sides of the mouth, and passes out behind the gill covers.

25. What is the general process of circulation?

The blood in the ventricle is forced into the main artery, which has in general a bulb at its base, called the '*arterial bulb*,' through which it is carried to the gills, and from thence is distributed to the body without returning first to the heart, which it reaches at last by veins leading to the auricle.

26. What peculiar organ do Fishes possess?

The swim-bladder or air-bag.

27. What is its use?

In most fishes it serves to alter the weight of the body by their enlarging or contracting its size, but in some few it appears to be used as a lung.

28. How is the brain of Fishes formed?

Of small ganglia, chiefly for the senses, which are all visible and separate.

29. What is there peculiar about the organs of sense?

The ears have no external opening, and the nose (except in some) has no opening into the throat.

30. Into what orders are Fishes divided?

1. *Cirrostomi.* 2. *Cyclostomi.* 3. *Teleostei.*
4. *Ganoidei.* 5. *Placoidei.* 6. *Dipnoi.*

31. What are the *Cirrostomi*?

The order includes only one strange fish, the *Lancelet.*

32. What are its distinguishing characters?

It has no vertebræ, no skull, no lower jaw, no brain, no heart, and no limbs.

33. Give a short description of it.

It has no distinct head, but has a median fin, which expands into a tail. The mouth is surrounded by threads; in the throat are numerous slits, through which the water passes and by means of which it breathes; instead of a vertebral column, it has a soft cord, called the '*notochord.*'

34. What does the name of the order refer to?

The threads surrounding the mouth.

35. Why are the *Cyclostomi* so called?

Because of their circular mouths.

36. What fishes does this order include?

The Lampreys and Hag-fishes.

37. What are the characters of the order?

1. Their skull is cartilaginous, and the vertebræ rudimentary.
2. They have no limbs,—only a median fin.
3. They have no arterial bulb.
4. The gills are in hollow sacs in the side of the neck.

38. What is the character of their mouth?

In the Hag-fishes there is a large recurved fang in the centre of the palate.

In the Lampreys, besides this, circular rows of sharp teeth are developed in the skin of the *mouth.*

39. What peculiarity is there about the nose?

In the Hag-fishes alone, the nose opens into the throat.

40. What are their habits?

Most Lampreys live in fresh water. Hag-fishes are marine, and eat their way into larger fishes.

41. What fishes are included in the *Teleostei*?

Almost all the well known ones, except Sharks and Rays.

42. Why are they so called?

Because their bones are perfectly formed and not cartilaginous.

43. What are their characters?

1. Their skeleton is bony.
2. Their gills are comb-like or tufted.
3. They have a non-muscular arterial bulb, with one row of valves in it.

44. Into what sub-orders are they divided?

1. *Malacopteri.* 2. *Anacanthini.*
3. *Acanthopteri.* 4. *Plectognathi.*
5. *Lophobranchii.*

45. What are the characters of the *Malacopteri*?

1. Their fin rays are soft, (whence the name,) except sometimes the first.
2. They always have a swim-bladder communicating with the throat.

46. What groups are contained in this order?

The Eels, which have no ventral fins, and the Herrings, Pikes, Salmons, &c., which have.

47. What are the characters of the *Anacanthini*?

1. They never have spiny rays, (whence the name).
2. The swim-bladder is either absent or closed.

48. What groups are contained in this suborder?

The Sand-eels, which have no ventral fins, and the Cods and Flat-fishes which have.

49. What is there peculiar about the Flat-fishes?

They are unsymmetrical, their two eyes being on one side, while they lie upon the other.

50. What are the characters of the *Acanthopteri*?

1. Their fins are supported by spiny rays, (whence the name).
2. Their swim-bladder is closed.
3. Their ventral fins are below or in front of the pectorals.

51. Name some fishes comprised in this suborder.

Perches, Mackerels, Anglers, and the Wrasses.

52. What are the characters of the *Plectognathi*?

1. Their jaw bones are immovably joined together, so that they cannot open their mouths so wide as other fishes, (whence the name).
2. Their skeleton is not completely ossified.
3. They have ganoid scales.
4. Their swim-bladder is closed.

53. How do they differ from the *Ganoids*?
Chiefly in the structure of the heart.

54. What fishes are included in this sub-order?
Only a few, the Trunk-fishes, &c.

55. What are the characters of the *Lophobranchii*?
Their gills are in tufts, instead of plates, (whence the name); in the characters of the scales, bladder and skeleton, they agree with the *Plectognathi*.

56. What fishes belong to this sub-order?
The curious so-called Sea-horses and Pipe-fishes.

57. What are the characters of the *Ganoids*?
1. They have ganoid scales.
2. Their skeleton is often mostly cartilaginous.
3. Their ventral fins are situated far back.
4. They have the ordinary breathing organs.
5. Their swim-bladder is connected with the throat, and is often divided into cells.
6. Their arterial bulb is muscular, and has several rows of valves.
7. Their intestine has often a spiral fold within.

58. In what characters do they differ from the *Teleostei*?
In their unossified skeleton, their ventral fins, the partition of their swim-bladder, their arterial bulb and their intestine.

59. In what characters do they differ from the Sharks and Rays?
In their ganoid scales, their gills, and in the possession of a swim-bladder.

60. What peculiar kind of fins are found in fishes of this order?

'Fringed-fins,' where the central part is the thickest.

61. Into what sub-orders are they divided?

Lepidoganoids and *Placoganoids*.

62. What fishes are included in the *Lepidoganoids*?

The American Bony-pike and others, as well as several fossil forms.

63. What is the Bony-pike remarkable for?

Its vertebræ are convex in front, like a reptile's.

64. What fishes are included in the *Placoganoids*?

The Sturgeon and others, and also some remarkable fossil fishes.

65. What are the Sturgeons remarkable for?

1. Their size.
2. The softness of their skeleton.

66. What are the remarkable fossil forms?

They are fishes of curious shape, found in the Old Red Sandstone: one has a head like a saddler's knife, and others are covered by a few large rough plates.

67. What fishes belong to the *Placoids*?

The Sharks and Rays, and others.

68. What are the characters of the order?

1. Their skeleton is cartilaginous, and their skull in one piece.
2. They have placoid scales.
3. Their ventral fins are far back.

4. The arterial bulb is muscular and has several rows of valves.
5. The gills are peculiar pouch-like organs.
6. Their intestine has a spiral valve.

69. Describe their gills.

They have a number of slits in the side of the neck (or one), which lead into pouches filled with branchial laminæ, and opening on the other side into the throat.

70. Into what two sub-orders are they divided?

The *Holocephali* and the *Plagiostomi*.

71. What are the *Holocephali*?

The *Chimæra*, and its allies: they have only one gill slit, their mouth is at the end of their head, and they have flat plates for teeth.

72. What are the characters of the *Plagiostomi*?

1. Their mouths are underhung, (whence the name).
2. They have several gill slits.
3. They have spiracles for breathing.

73. What groups of Sharks are there?

1. The Grinding Sharks.
2. The Biting Sharks.

74. Give particulars about the Grinding Shark.

There is only one living, the Port Jackson Shark, with its jaws covered with a pavement of flat rough grinding teeth.

75. Give particulars of the Biting Sharks.

The whole interior of their mouth is covered by sharp teeth pointing towards the throat, their eggs are enclosed in cases, often called '*mermaids' purses*.'

76. Describe the Rays.

Their body is spread out in a flat disc, formed chiefly of the expansion of their fore limbs; the hind limbs are also conspicuous; the eyes are on the upper surface, and the mouth on the lower.

77. What remarkable fishes are comprised in this family?

The Torpedo and the Saw-fish.

78. What fishes are comprised in the *Dipnoi*?

Only the *Lepidosiren*, or Mud-fish, and another.

79. What is there remarkable about the *Lepidosiren*?

It combines the characters of fishes and amphibians.

80. Why is the order called *Dipnoi*?

Because the *Lepidosiren* breathes in two ways: by lungs and by gills.

81. Describe the *Lepidosiren*.

It is fish-like, with a fringe for its tail, and four thread-like organs for limbs; its skeleton is mostly cartilaginous; it is covered with cycloid scales; its nose opens into its throat.

82. Why is it called a *Mud-fish*?

Because when the river dries up it buries itself in the hardened mud, during which time it breathes air.

83. In what characters does it agree with Fishes?

1. Its shape and scales.
2. Its having gills in a separate chamber.

84. In what characters does it agree with Amphibians?

1. *Its heart* is composed of two auricles and one ventricle.

2. It has true lungs, by which it breathes air.
3. It sometimes has external gills.

85. What other remarkable mud-fish has been discovered in Australia?

The *Ceratodus*, which seems to unite the *Lepidosiren* to the *Ganoids*.

AMPHIBIA.

1. What are the chief characters of the *Amphibia*?

1. They undergo a metamorphosis, breathing water by gills when young, and air by lungs when adult, (whence the name.)
2. The heart consists of two auricles and one ventricle.
3. The skull articulates with the neck by two processes, or '*condyles*.'

2. In what do they differ from Reptiles?

In their breathing by gills when young, by the double condyle of the skull, and by the absence of scales.

3. Where are their gills situated?

Some are internal, others external; the latter are retained by a few throughout life.

4. What names are given with respect to their losing or not their external gills?

Those that lose them entirely are called '*Caducibranchiate*'; those in which they remain throughout life together with the lungs are called '*Perennibranchiate*.'

5. How is the change effected?

More and more blood is gradually passed through the veins of the lung, and less to the gills, so that the latter decrease, and the former grow, and at the junction near the heart, form a second auricle.

6. Into what orders are the living *Amphibia* divided?

The *Ophiomorpha*, *Urodela*, and *Anura*.

7. Which are the commonest of these?

The *Urodela*, or Newts, and the *Anura*, or Frogs and Toads.

8. What are the *Ophiomorpha*?

They are worm-like animals, which burrow in the mud, but are known to undergo a metamorphosis.

9. What are their peculiar characters?

They have no limbs, and their eyes are rudimentary.

10. Why are the *Urodela* so called?

Because their tail is retained throughout life; for the same reason they are called '*Tailed Amphibians*.'

11. What are their characters?

1. Their tail is retained.
2. Their vertebræ are never convex behind.
3. They have short ribs.
4. The bones of their fore arm and leg are not joined in one.
5. The fore limbs are developed first.

12. Into what two sections are they divided?

The Perennibranchiata and the *Caducibranchiata*.

13. Which are the chief kinds of the *Perennibranchiata*?

The *Proteus*, which inhabits dark caves.
The *Siren*, which makes a peculiar noise.
The *Axolotl*, which is eaten in Mexico.

14. What are the chief kinds of the *Caducibranchiata*?

The Water Salamanders or Newts, whose tail is flattened, and the Land Salamanders, whose tail is round.

15. Why are the *Anura* so called?

Because their tails shrink up and disappear in the adult; for the same reason they are called '*Tailless Amphibians*.'

16. What are their characters?

1. They lose their tails.
2. Their vertebræ are convex behind.
3. They have no ribs.
4. The bones of the fore arm and leg are joined in one.
5. The hind limbs are developed first.
6. They are always caducibranchiate.

17. By what process do they breathe?

There being no ribs they cannot enlarge the chest in the ordinary way, so they fill the mouth with air, and then force it into the lungs, like swallowing.

18. Describe the development of the Frog.

1. They are at first tadpoles, with flattened tails and external gills.
2. The external gills shrink up.

3. The hind limbs are developed, and then the fore.
4. The internal gills disappear, and then the tail.

19. What are the chief kinds of *Anura*?

The Frogs and the Toads, the Surinam Toads, and the Tree-frogs.

20. What are the characters of the Surinam Toads?

1. There is no tongue.
2. The male carries the eggs in depressions on the back.

21. What are the characters of the Toads?

1. They have no teeth.
2. The hind limbs are not much larger than the fore.

22. What are the characters of the Frogs?

1. They have teeth in the upper jaw.
2. Their hind limbs are much larger than the fore.

23. What is the peculiarity of the Tree-frogs?

Their toes have suckers, by which they climb.

24. What are the *Labyrinthodontia*?

Gigantic fossil amphibians, whose feet were like human hands, and the hind limbs much larger than the fore.

25. Why are they so called?

Because the substance of their teeth is wonderfully folded, like a maze.

REPTILES.

1. In what characters do Reptiles and Birds agree?

1. The skull joins the first cervical vertebra by one condyle only.
2. The lower jaw is attached to the head by a separate bone, called the '*quadrate bone*.'
3. They have nucleated blood-corpuscles.
4. The lower jaw is composed of three pieces.

2. In what characters do Reptiles differ from Birds?

1. Their blood is cold.
2. The heart has one ventricle and two auricles.
3. They have no wings, feathers, &c.

3. Mention any other characters of Reptiles.

1. Their skeleton is always bony.
2. Their teeth (except in crocodiles) have no separate sockets.
3. They have well developed ribs.
4. Their lungs are large and not very cellular.
5. They are covered with scales or hard plates.

4. What names are given to different sections according to their coverings?

The '*Squamata*,' when they have only horny scales, as the Serpents.

The '*Loricata*,' when they have bony plates, as the *Crocodiles*.

5. What is the course of the circulation in Reptiles?

The venous blood, from the body, is poured into the right auricle, and the arterial blood from the lungs, into the left auricle, whence they both are poured into the single ventricle, where they mix; so the blood sent to the body is only half pure, and that to the lungs only half impure.

6. What are the orders of living Reptiles?

1. *Chelonia*, or Turtles.
2. *Ophidia*, or Snakes.
3. *Lacertilia*, or Lizards.
4. *Crocodilia*, or Crocodiles.

7. What are the characters of the *Chelonia*?

1. Their internal and external skeletons join to form an immovable case, in which the body is enclosed.
2. The bones of the skull are joined immovably together.
3. The two lower jaws are all joined in one.
4. They have no teeth, but beaks.
5. The ribs and vertebræ are joined immovably together, and the latter have no transverse processes.
6. The scapular and pelvic arches are covered by the case, so that the former is within the ribs.

8. What is the general nature of their skeleton?

It is as compact as possible.

9. What is Tortoiseshell?

It is the horny covering outside the bony *case.*

10. What are the names of the upper and under parts of the case?

The upper is called the '*carapace*.'

The lower is called the '*plastron*.'

11. Of what parts is the carapace composed?

1. A central row of plates, formed by the neural spines of the vertebræ.
2. Two side rows of long '*costal*' plates, formed by the ribs.
3. A row of plates surrounding the rest, called '*marginal*' plates.

12. Of what parts is the plastron composed?

Of nine plates of various sizes.

13. Can these plates be seen on the outside?

No: they are generally covered with tortoise-shell, in plates quite independent of the bones below.

14. What different kinds of the *Chelonia* are there?

1. The Swimming ones, or Turtles.
2. The Amphibious or Fresh-water Tortoises.
3. The Land Tortoises.

15. What are the characters of the *Ophidia*?

1. The skeleton consists only of the uniform vertebral column, (and rarely rudimentary hind limbs).
2. Their jaws have a peculiar loose arrangement.
3. They have no movable eyelids.
4. Their dorsal vertebræ are hollow in front.

16. What is the general character of their skeleton?

It is as loose as possible.

17. How do they move?

By the motion of their ribs, which are attached by muscles to their under side.

18. How are they covered?

By a skin with horny scales, which is cast off at regular times.

19. What is the arrangement of the jaws?

The two sides of the lower jaw are only loosely connected in front, behind they articulate with the movable quadrate bone, which articulates with a movable portion of the skull.

20. What is the object of this arrangement?

To enable the mouth to expand to swallow large animals.

21. What is the structure of their teeth?

They have conical teeth, fixed to the jaw bones, and not set in separate sockets, and the venomous ones have two long curved fangs on the upper jaw.

22. How do the poison fangs act?

They have a canal on the convex side, which communicates with a gland at the base in the side of the jaw; when they strike their prey the muscles press this gland and force the poison down the canal into the wound.

23. What is the structure of the tongue?

It is long and slender, and forked at the end.

24. What is the structure of the eye?

It is surrounded by a circle of scales, to which is attached a transparent horny covering which protects the eye in front.

25. What are the two kinds of *Ophidia*?

*The Vipe*rine and the Colubrine Snakes.

26. What is the distinction between them?

The Viperines have no other teeth than poison fangs in their upper jaw bones.

The Colubrines have solid teeth only, or both.

27. How may they otherwise be distinguished?

The Viperines have more distinct heads, and small scales on them.

The Colubrines have less distinct heads, and large scales on them.

28. Mention some of the Viperines.

The Common Viper, and the Rattlesnakes, which have some loose rings on their tails which rattle as they move.

29. Mention some of the Colubrines.

The Common harmless Snakes.

The Boa Constrictors, which are not poisonous, but crush their victims to death.

The venomous Hooded Snakes or Cobras.

30. What are the characters of the *Lacertilia*?

1. They have generally four limbs, and always a scapular arch.
2. Their jaws are not loosely joined.
3. They have movable eyelids.
4. They have no bony scutes in their skin.

31. Are any of the *Lacertilia* serpent-shaped?

Some, as the Blind-worm.

32. Mention any other interesting forms.

The Iguanas, with curious shaped crimped teeth.

The Flying Lizards, which have a membrane on each side, stretched on false ribs.

The *Chameleon*, which changes its colour.

33. What are the characters of the *Crocodilia*?

1. They are covered with bony plates.
2. Their teeth are implanted in distinct sockets.
3. They have two separate ventricles in the heart as well as the two auricles.
4. The anterior ribs have double heads.
5. Their sternum is largely developed.

34. Is their circulation different from that of other Reptiles?

No; for though the ventricles are completely divided, the arteries communicate just outside the heart.

35. What is there peculiar about the Crocodile's mouth?

It can be held open, and yet completely shut off behind from the throat, by a hard band crossing it, so that it can breathe with its nose while its mouth is open under water.

36. What is the character of the vertebræ of all living Crocodiles?

They are hollow in front; fossil kinds have them hollow behind, or on both sides.

37. What are the chief kinds?

The Gavial, of India.
The Crocodile, of the Nile.
The Alligator, of America.

38. How may these be distinguished?

In the Gavial all the teeth are alike.

In the Crocodile the fourth tooth of the lower jaw is larger and is visible externally.

In the Alligator this same tooth is received into *a pit in the* upper jaw.

39. What are the most important of the fossil Crocodiles?

The *Teleosaurus*, whose vertebræ were concave on both sides.

The *Ceteosaurus*, whose vertebræ were concave behind, and which was very large, reaching perhaps fifty feet.

40. What are the extinct orders of Reptiles?

1. *Ichthyopterygia.*
2. *Sauropterygia.*
3. *Anomodontia.*
4. *Pterosauria.*
5. *Dinosauria.*

41. Which is the chief of the *Ichthyopterygia*?

The *Ichthyosaurus.*

42. Describe it.

It was fish-like in shape, it had a soft skin and probably a vertical tail, its head was large and jaws strong, its teeth were not implanted in distinct sockets, its eyes were enormous, and had a ring of bony plates, its neck was very short, its vertebræ were biconcave; its ribs were numerous, and there were false ones besides in the abdomen, its limbs were broad paddles with extra rows of bones besides the five principal, it had no sacrum or sternum.

43. What were its probable habits?

It was carnivorous, and very powerful, it swam in the deep sea, and occasionally came near land.

44. Which is the chief of the *Sauropterygia*?

The *Plesiosaurus.*

45. Describe it.

It was long and narrow, covered with soft skin; its head was small, its teeth implanted in distinct

sockets, there were no bony plates in the eyes. Its neck was long, its vertebræ nearly flat, its ribs short, and some false ones in the abdomen; its paddles were long and narrow, consisting of only five rows of long bones, its tail was rather short.

46. What were its probable habits?

It either skimmed the surface and darted at the fish with its long neck, or lurked in shallow water, stretching its neck upwards to the surface.

47. What are the *Anomodontia*?

They were land reptiles, with jaws cased in horn like rounded beaks, and without teeth, except in some which had two large tusks in the upper jaw: they are found mostly in Africa.

48. What is the common name for the *Pterosauria*?

Pterodactyles.

49. Describe a *Pterodactyle.*

It had large strong jaws, with teeth in distinct sockets; it had bony plates in the eyes. Its neck vertebræ were very strong, its dorsal vertebræ were concave in front. It had a sternum with a central ridge. Its arms were long, and it had four fingers, the outermost was almost as long as the body, and supported a membrane which reached the hind limbs. Its bones were filled with air cells.

50. What were its probable habits?

It undoubtedly had great powers of flight, and was carnivorous.

51. *Why* are the *Dinosauria* so called?

Because of their enormous size.

52. Which are the two chief kinds?
The *Megalosaurus* and the *Iguanodon.*

53. Give particulars of the *Megalosaurus.*
It was about fifty feet long; its feet had claws, and it walked on the land; it had jagged teeth, and was carnivorous.

54. Give particulars of the *Iguanodon.*
It was about sixty feet long; its hind legs were much larger than its fore legs, and it probably walked on the former only; it had teeth like the iguana, and was herbivorous.

BIRDS.

1. What are the peculiar characters of Birds?
   1. They are covered with feathers.
   2. Only their hind limbs are used for walking.
   3. They have a double circulation, and the heart is in four chambers.
   4. Their blood is warm.
   5. Their bones and body have air receptacles.
   6. They have also some characters in common with reptiles.

2. Describe the structure of a feather.
It consists of:
   1. A tube or quill at the base.
   2. A long grooved stem, called the '*shaft.*'
   3. Two side pieces called the '*webs,*' which are formed of a number of parallel '*barbs,*' which have smaller '*barbules*' branching from them, which interlock generally with each other.

3. What different names do feathers receive?

There are '*clothing feathers*' covering the body, and '*quill feathers*' in the wings and tail. Those of the wing are called '*primaries*,' '*secondaries*,' &c., according to their position, and others are named after the parts of the body they cover.

4. Describe the skull of Birds.

It is all joined into a single piece; there are no teeth; the lower jaw articulates with the skull by a quadrate bone, and the skull articulates with the neck by a single condyle.

5. Describe the vertebral column.

The neck vertebræ are numerous: many of the dorsal vertebræ are anchylosed* together: the long sacrum, consisting of several united vertebræ, comes next the dorsal: the caudal vertebræ are eight or ten, and the last in most is like a ploughshare, and is therefore called the '*ploughshare bone.*'

6. Describe the ribs.

They are kept connected with one another by short cross pieces, which come from one and are bound to the next; they are connected to the sternum by '*sternal ribs.*'

7. Describe the sternum.

It is a broad convex plate of bone, generally of large size, and in those that fly has a strong ridge or keel down the centre.

8. Describe the pectoral arch.

It consists on each side of a narrow scapula and a strong coracoid firmly attached to the ster-

* *When two* bones grow together they are said to be anchylosed.

num, and two clavicles joined in the centre into one bone, called the '*furculum*,' which is attached by ligament or suture to the sternal keel.

9. How is the fore limb formed?

The radius is smaller than the ulna; there are only three metacarpals, of which two are joined into one bone, these are followed by a few digits, joined together and pointed; there is a small thumb bone at the nearer end of the metacarpals.

10. Describe the pelvic arch.

The ilium, ischium, and pubes on each side are anchylosed into one innominate bone, and this is anchylosed to the sacrum.

11. Describe the hind legs.

The tarsus is, so to speak, broken in the middle, the upper half being anchylosed to the tibia, and the lower half to the metatarsus forming the so-called '*tarso-metatarsus*.' They have four or fewer toes, the first, second, third, and fourth toes have two, three, four, and five digits respectively.

12. What is the digestive system?

The throat leads first into a crop, then comes the true stomach (or '*proventriculus*'), then the gizzard, then the small intestine, into which two long blind tubes enter, then the large intestine and cloaca.

13. What is there remarkable in the respiratory system?

The bronchi* open (besides into the lungs) into a number of air sacs placed about the body,

* The bronchus is the tube branching from the windpipe into the lungs.

and even communicate with air chambers in the bones.

14. What is there peculiar about their eyes?

They are protected by a circle of bony plates, and have a third eyelid.

15. What is the organ of song?

It is called the '*inferior larynx*,' and is situated at the base of the trachea, at the junction of the two bronchial tubes, and is formed of special bones and muscles.

16. How are Birds divided with respect to their habits?

They are 1st, *Heterophagi*, when the young are born naked and helpless, or *Autophagi*, when they are feathered and self-feeding at birth; and 2nd, they are 'Permanent Birds' which keep in one locality, or 'Wandering Birds' which change their homes at random, or 'Migratory Birds' which leave for other climates at definite seasons each year.

17. Into what three divisions have Birds been classified?

1. The *Saururæ*, or Lizard-tailed.
2. The *Ratitæ*, or Rafted.
3. The *Carinatæ*, or Keeled.

18. What are the *Saururæ*?

There is in this division but a single fossil bird, the *Archæopteryx*, with a tail like a reptile's.

19. State its chief peculiarities.

1. Its tail consisted of a number of vertebræ, with two feathers each.
2. It had no ploughshare bone.
3. *It* had claws belonging to its wings.
4. *Its* metacarpal bones were separate.

20. What is the commoner name for the *Ratitæ*?

The *Cursores*, because they do not fly but run.

21. What are their characters?

1. Their wings are rudimentary.
2. The barbules of their feathers are separate.
3. There is no keel to the sternum.
4. Their pelvic arch is united in front in some.
5. They have no inferior larynx.
6. Their last vertebra is not like a ploughshare.

22. What are the chief members of the order?

The Ostriches, Emeu, Cassowary, Apteryx, and Dinornis.

23. What are the peculiarities of the Ostriches?

They have vast powers of running, they have two toes, and they lay their eggs in the sand, and their head is naked.

24. What are the peculiarities of the Emeu?

They are found in Australia only, and have feathered heads, and three toes.

25. What are the peculiarities of the Cassowary?

The head has a horny crest.

26. What is the Apteryx?

It is a smaller bird, with feathers like hairs; with a long beak, and a hind toe; it is nocturnal, and lives upon insects.

27. What is the Dinornis?

A gigantic New Zealand bird, recently exterminated by man.

28. What are the orders of the *Carinatæ*?

The *Natatores*, or Swimmers; *Grallatores*, or Waders; *Rasores*, or Scratchers; *Scansores*, or Climbers; *Insessores*, or Perchers, and *Raptores*, or Birds of Prey.

29. What are the characters of the *Natatores*?

1. They are swimming birds.
2. Their feet are more or less webbed.
3. They are covered with down.

30. Which are the chief families of the *Natatores*?

The *Brevipennatæ*, or short winged.
The *Longipennatæ*, or long winged.
The *Totipalmatæ*, or completely webbed.
The *Lamellirostres*, or flat billed.

31. Which are the chief of the *Brevipennatæ*?

The Penguins, Auks and Divers.

32. Which are the chief of the *Longipennatæ*?

The Gulls and Petrels.

33. Which are the chief of the *Totipalmatæ*?

The Pelicans and Cormorants.

34. In what respect are they completely webbed?

The first or hind toe is turned forwards and united by a web to the rest.

35. Which are the chief of the *Lamellirostres*?

Ducks, Geese, Swans and Flamingoes.

36. What is there peculiar about the Flamingoes?

Their legs are so long they approach the *Grallatores*.

37. What are the characters of the *Grallatores*?
Their legs are exceedingly long.
There are no feathers below the tibia.
They frequent marshy places.

38. Which are the chief families of the *Grallatores*?
The *Macrodactyli*, or long-toed.
The *Cultirostres*, or ploughshare billed.
The *Longirostres*, or long-billed.
The *Pressirostres*, or compressed billed.

39. Which are the chief of the *Macrodactyli*?
The Rails, Waterhens and Corncrakes.

40. What are their chief peculiarities?
They are comparatively short-legged, short-necked birds.

41. Which are the chief of the *Cultirostres*?
The Cranes, Herons and Spoonbills.

42. What are their peculiarities?
Their long legs and bills, and their four toes being partially webbed together.

43. Which are the chief of the *Longirostres*?
The Snipes and Curlews.

44. Which are the chief of the *Pressirostres*?
The Plovers and the Bustards.

45. What are the characters of the *Rasores*?
1. They have three strong anterior toes, with claws formed for scratching, and one hind toe.
2. They are granivorous, and have strong gizzards.

46. What are the two divisions of them?
The *Gallinacei* and *Columbacei*.

47. What are the chief of the *Gallinacei*?

Fowls, Turkeys, Partridges, Pheasants and Grouse.

48. What are their peculiarities?

They are bad fliers, the males have a spur, they are mostly polygamous, they crow, and their young are self-helping when born.

49. What are the chief of the *Columbacei*?

Doves and Pigeons, and the Dodo.

50. What are their peculiarities?

They are good fliers, they have slender feet, they are monogamous, they coo, and their young are helpless when born.

51. What is the Dodo?

It is a bird of the Mauritius, recently extinct; it was larger than a swan, awkward in appearance, with rudimentary wings, ostrich feathers, and hooked beak.

52. What is the chief character of the *Scansores*?

They have two toes turned forward and two backward.

53. What are the chief kinds of the *Scansores*?

The Cuckoos, Woodpeckers and Parrots.

54. What is the peculiarity of the Cuckoos?

They lay their eggs in other birds' nests.

55. What is the chief character of the Woodpeckers?

The curious structure of their protrusible tongue.

56. What is the chief character of the Parrots?

They have hooked bills, like birds of prey.

57. What are the characters of the *Insessores*?
They have three slender toes in front and one behind; the young are born helpless; the finest voices and most beautiful plumage are in this order, which is the largest of all.

58. Into what sections is it divided?
The *Conirostres*, with conical beaks.
The *Dentirostres*, with notched beaks.
The *Tenuirostres*, with slender beaks.
The *Fissirostres*, with wide gaping beaks.

59. Name any birds belonging to the *Conirostres*.
Sparrows, Hornbills, Birds of Paradise, Finches and Cross-bills.

60. Name any birds belonging to the *Dentirostres*.
Shrikes, Thrushes and Robins.

61. Name any birds belonging to the *Tenuirostres*.
Wrens, Lyre-birds and Humming-birds.

62. Name any birds belonging to the *Fissirostres*.
Swallows, Goat-suckers and King-fishers.

63. What are the characters of the *Raptores*?
1. They have strong-pointed sharp beaks.
2. Their toes, three in front and one behind, have sharp claws.
3. They are carnivorous.

64. Into what two divisions are they formed?
The *Nocturnal* and *Diurnal*.

65. What birds of prey are Nocturnal?
The Owls.

66. What are the peculiarities of the Owls

Their plumage is very soft, and the feathers form discs round the eyes which point forwards; their third toe can be bent backwards, and they have no crop.

67. What are the chief Diurnal birds of prey?

The Eagles and Vultures.

68. What are the chief differences between these?

The Eagles have eyebrows and feathers on the face. The Vultures have no eyebrows, and their heads are generally bare.

MAMMALIA.

1. What are the peculiar characters of the *Mammalia*?

1. The young are nourished by milk.
2. They have hairs on some part of their body.
3. The skull joins the neck by two condyles.
4. The lower jaws are in one piece on each side, and articulate directly with the skull.
5. The thorax is separated from the abdomen by a diaphragm.
6. The blood corpuscles are non-nucleated.
7. They are viviparous.

2. What peculiar vertebræ are there in the neck?

The first is called the 'atlas,' and is hollow.

The second is called the 'axis,' and has a pro-

cess called the '*odontoid process*,' which is really the centrum of the atlas.

3. How many cervical vertebræ are there?

Almost always seven.

4. To how many vertebræ does each rib articulate?

To two.

5. What is the peculiarity of the teeth of *Mammals*?

They are of different sorts, and some have double fangs, and in most a second set are grown.

6. What are the different sets called?

The first set are the '*deciduous*' teeth.

The second set are the '*permanent*' teeth.

7. What names are given to *Mammals* according as they have one or two sets?

'*Monophyodont*,' when they have one.

'*Diphyodont*,' when they have two.

8. What are the names of the different kinds of teeth?

'*Incisors*,' '*canines*,' '*premolars*' and '*molars*.'

9. What is the nature of these kinds?

The incisors are sharp cutting teeth, in the front of the jaw.

The canines are single strong pointed teeth, at the junction of two bones of the upper jaw.

The premolars are grinding teeth, which displace the deciduous molars of the first set.

The molars are grinding teeth, not developed till the second set.

10. What is there peculiar about molar teeth?

They have more than one fang.

11. How many of each sort are there on an average?

Three incisors, *always* one canine if any, four premolars, and three molars.

12. What is the circulatory system?

It is the same as birds, i.e., they have a systemic and pulmonary circulation, and four distinct chambers in the heart.

13. What is there remarkable in their nervous system?

The brain is comparatively large.

14. Into what parts is the brain divided?

The '*cerebrum*' and '*cerebellum*'; each of which is divided into two lobes, and those of the cerebrum are joined by what is called the '*corpus callosum*.'

15. How are the eyes protected?

They mostly have a third eyelid, but no bony plates.

16. Into what sub-classes are *Mammals* divided?

Placental and *Implacental.*

17. What is the distinction between these?

In the *Placental*, the young before birth are nourished by the mother's blood by means of the '*placenta*.'

In the *Implacental* they are not, but are born in an imperfect condition.

18. What other classification is there?

The *Lyencephala*, *Lissencephala*, *Gyrencephala*, *Archencephala.*

19. On what is this founded?

On the size and convolution of the cerebrum.

20. What third classification is there?

The *Ornithodelphia*, *Didelphia* and *Monodelphia*.

21. On what is this founded?

On the differences of the organs of reproduction.

22. How are these classifications connected?

The *Lyencephala* is equivalent to the *Ornithodelphia* and *Didelphia* together, and also to the *Implacental*.

23. What are the characters of *Implacental Mammals*?

1. They have no placenta.
2. Their young are born in an immature state.
3. They have '*marsupial bones*.'
4. Their corpus callosum is rudimentary.
5. None of the lobes of the brain are overlapped by the cerebrum. (*Lyencephala*.)

24. What are the '*Marsupial bones*'?

They are two bones attached to the pelvis, and support the marsupial pouch when there is one.

25. What are the orders of the *Implacentals*?

The *Monotremata* and *Marsupialia*.

26. What are the characters of the *Monotremata*?

1. There is but one exit from their bodies (*Ornithodelphic*).
2. They have no marsupial pouch.
3. They have no true teeth.
4. There are no nipples.

27. What animals belong to this order?

The Duck-mole and Porcupine Ant-eater.

28. Describe the Duck-mole.

It is like a large mole, covered with soft brown hair; it has a broad tail, and a flat bill like a duck's: its feet have five clawed toes, joined by a membrane.

29. Describe the Porcupine Ant-eater.

It is like a porcupine, covered with long spines; its mouth is long and tapering, and closed except at the end by skin.

30. What are the characters of the *Marsupialia*?

1. They are *Didelphic.*
2. They possess a marsupial pouch.
3. The lower jaws of most are bent in behind.

31. What is the marsupial pouch?

It is a fold of the skin of the abdomen into which the young are put at birth, and are there attached to the teats.

32. How are they enabled to feed before they are able to suck?

The milk is forced into their mouths by special muscles in the mother's teats.

33. Into what sections are the *Marsupialia* divided?

1. The *Rhizophaga*, or root eaters.
2. The *Poephaga*, or grass eaters.
3. The *Carpophaga*, or fruit eaters.
4. The *Entomophaga*, or insect eaters.
5. The *Sarcophaga*, or flesh eaters.

34. What is there remarkable about these divisions?

They correspond to a great extent with several orders of the *Monodelphians*.

35. What is the most typical of the *Rhizophaga*, and to what order do they correspond?

The Wombat, whose teeth and habits are like those of the *Rodentia*.

36. What are the most typical of the *Poephaga*, and to what order do they correspond?

The Kangaroos, whose stomach is like that of the *Ruminantia*, (a sub-order of *Artiodactyla*).

37. What are the most typical of the *Carpophaga*, and to what order do they correspond?

The Phalangers, whose feet and habits correspond to those of the Sloth among the *Edentata*.

38. What are the most typical of the *Entomophaga*, and to what order do they correspond?

The American (not Australian) Opossums: the whole section corresponding generally to the *Insectivora*.

39. What is the most typical of the *Sarcophaga*, and to what order do they correspond?

The *Thylacinus*, which correspond to the *Carnivora* in teeth and habits.

40. What are the orders of *Placental Mammals*?

Rodentia, *Insectivora*, *Cheiroptera*, *Bruta* with smooth brains, (*Lissencephala*); *Cetacea*, *Sirenia*, *Proboscidea*, *Perissodactyla*, *Artiodactyla*, *Carnivora*, *Quadrumana* with convoluted brains, (*Gyrencephala*); and *Bimana*, (*Archencephala*).

41. Which orders contain the *Monophyodonts*?

The *Monotremata*, *Bruta* and *Cetacea*.

42. What are the characters of the *Rodentia*?

They have two incisors in each jaw, which are

always growing, and are kept sharp by wear; these are separated by a wide space from the molars, and there are no canines.

43. Which are the chief animals included in this order?

Rabbits, Guinea-pigs, Porcupines, Beavers, Rats, Mice, Jerboas, Dormice and Squirrels.

44. Which of these have perfect clavicles?

All, except the first three.

45. What is the peculiarity of the Rabbits and Hares?

They have two extra canines behind the others, in the upper jaw.

46. What is the peculiarity of the Porcupines?

They are covered by long spines like quills.

47. What is the peculiarity of the Beavers?

They are large for rodents, and have their hind feet webbed for swimming; they are also remarkable for forming dams across rivers.

48. What is the peculiarity of the Jerboas?

Their hind limbs are much larger than their fore limbs, so that they sit upright and leap like Kangaroos.

49. What are the characters of the *Insectivora*?

They have peculiar molar teeth, with many sharp cusps, adapted for crushing insects; in most other respects they resemble the *Rodentia*.

50. Which are the chief members of this *order?*

Moles, Shrew-mice and Hedgehogs.

51. What are the peculiarities of the Moles?

They are blind, and their fore limbs are formed very strongly for digging.

52. What is the peculiarity of the Hedgehogs?

Their back is covered with long spines, and they roll themselves into a ball when alarmed.

53. What are the characters of the *Cheiroptera*?

The fingers of their hands are very long, and are joined together and to their body, by a skin called the '*patagium*,' by means of which they fly.

54. What are their habits?

They fly in the dusk, and hang themselves up by their thumbs in crevices in the day and during winter.

55. What are the two sections of the *Cheiroptera*?

The *Insectivorous* and *Frugivorous* Bats.

56. How are they distinguished?

By their habits, and by the shape of their molar teeth corresponding to them.

57. What are the characters of the *Bruta*?

1. They are defective in their teeth, few having anything but molars.
2. Their toes are furnished with long claws.

58. What are the two great sections of the *Bruta*?

The Plant-eaters, or Sloths.

The Insect-eaters, or Armadillos and Ant-eaters.

59. Why are they called Sloths?

Because they move slowly and awkwardly on the ground.

60. What are their habits?

They cling to the under side of the branches of trees, where they feed and even sleep.

61. What is their structure?

They are covered with hair, and have a complex stomach; their fore limbs are much longer than the hind ones, and all are furnished with long hooked claws; they have three or two toes.

62. What is the Armadillo?

It is a burrowing animal, with strong claws; its back is covered with bony plates, with movable bands; its molars are exceedingly numerous.

63. Which is the best known of the Ant-eaters?

The Great Ant-eater, which has a long snout with an opening at the end, and strong claws for breaking into the nests of the Termite Ants.

64. What are the *Sirenia* and *Cetacea* called together?

Mutilata, because they have no hind limbs, and their fore limbs are in the form of fins.

65. In what characters do the *Sirenia* and *Cetacea* agree?

1. In their fish-like form.
2. In their horizontal tail.
3. In the formation of their limbs.
4. In having no clavicles.

66. What are the three families of *Cetacea*?

The Whalebone Whales, the Sperm Whales and the Dolphins.

67. What are the chief peculiarities of the Whalebone Whales?

1. Their size.
2. The structure of their mouth.
3. Their spiracles.

68. What is their size?

They sometimes reach 100 feet, and are the largest of all known animals.

69. What is the structure of their mouth?

It reaches nearly to one-third of the whole body, it has no teeth, but in the upper jaw are two rows of numerous plates of '*baleen*,' or whalebone, which run into a fringe at the edge and serve to sift out the minute animals on which it lives.

70. What are the spiracles?

The openings of their noses on the top of the head, from which they appear to throw out a column of water when they rise to the surface.

71. What are they sought for?

Partly for the whalebone, and partly for the blubber, or layer of fat, beneath the skin, which affords oil.

72. What are the peculiarities of the Sperm Whales?

They have numerous conical teeth in the lower jaw, and are gregarious.

73. What are they sought for?

Spermaceti and Sperm-oil, both of which are obtained from their blubber.

74. What are the peculiarities of the Dolphins?

They have conical teeth in both jaws, and their head is proportionally smaller, and they are altogether smaller animals.

75. What are the commonest of them?

The Dolphin, the Porpoise, and the Grampus.

76. What is the Narwhal?

It is included in this family but has only one tooth, an incisor, developed in the form of a long spirally twisted tusk.

77. In what do the *Sirenia* differ from the *Cetacea*?

1. Their heads are not so large, but more distinct.
2. Their nostrils are on the end of the snout and not on the top of the head.
3. They possess molar teeth with flattened crowns, and are *dyphodont.*

[4. They have minor peculiarities.]

78. What used they to be called?

The *Herbivorous Cetacea.*

79. What are the two chief kinds of *Sirenia*?

Manatees and *Dugongs.*

80. How do these differ?

The *Manatee* has more molars.

The *Dugong* has tusk-like incisors in the upper jaw.

81. What are the *Proboscidea, Perissodactyla,* and *Artiodactyla,* called together?

The *Ungulata,* because their feet have hoofs.

82. What characters have they in common?

1. The feet end in hoofs, (hence the name).
2. They have no clavicles.
3. They are vegetable feeders.

83. What are the characters of the *Proboscidea*?

1. They have a long trunk, (whence the name).

2. They have peculiar large molars, and two tusk-like incisors.
3. Their skin is thick.
4. Their toes are five and only slightly separate.

84. What living animals are comprised in this ·der?

The African and the Indian Elephants.

85. How do these differ?

The African Elephant has larger ears, and the dges of the molars are lozenge-shaped instead of ansverse.

86. What extinct animals belong to it?

The *Mastodon* and the *Mammoth.*

87. Why are the *Perissodactyla* and *Artio-ıctyla* so called?

Because the *Perissodactyla* have an odd num-ɔr of toes (one or three), and the *Artiodactyla,* ı even number (two or four).

88. What other distinction have they?

The horns, if present, are not paired in the *erissodactyla,* (and their femur has a third ochanter).

89. What are the chief families of the *Peris-dactyla*?

The *Multungula,* including the Rhinoceroses, yrax and Tapirs; and the *Solidungula.*

90. What are the peculiarities of the Rhino-ıros?

Their thick hard skin, and the horn on the nose.

91. What are the two chief kinds?

The one-horned, and the two-horned in which ıe second horn is behind the other.

92. What are the peculiarities of the Hyrax?

They are small animals, whose incisor teeth are like those of rodents; they have four unequal toes on the front feet, and three behind, and a rudimentary tail.

93. Are they certainly belonging to this order?

They have been formed into a separate order, called the *Hyracoidea*, chiefly on account of characters connected with reproduction.

94. What are the peculiarities of the Tapirs?

They have a short trunk, and their front feet have four unequal toes.

95. What are the peculiarities of the *Solidungula*?

Their feet have but one toe in a broad hoof, and they are covered with hair forming a mane on the neck.

96. Which are the chief members of this family?

Horses, Asses and Zebras.

97. What are the chief characters of the *Artiodactyla*?

1. They have two or four toes.
2. Some have pairs of horns on bony cores.
3. The stomachs are more or less complex.

98. Into what two sections are they divided?

The *Omnivora* and the *Ruminantia*.

99. Why are the *Omnivora* so called?

Because their teeth are adapted for eating all kinds of food.

100. What are the chief kinds of *Omnivora*?

The Hippopotamus and the Hogs.

101. What are the peculiarities of the Hippopotamus?

It has a broad jaw, with large canines: it is an huge unwieldy animal, living in the African rivers; it has four toes.

102. What are the peculiarities of the Hogs?

They have long round snouts, and canines in the form of tusks; with only two toes reaching the ground.

103. What are the *Pachydermata*?

They are an old order of Mammals, characterised by having thick skins; but they are now distributed among the orders of the *Artiodactyla*.

104. What animals were included in this order?

The Elephant, Rhinoceros, Tapir, Hippopotamus and Hogs.

105. Why are the *Ruminantia* so called?

From their habit of ruminating, or chewing the cud.

106. What are the characters of the *Ruminantia*?

1. Their feet have two toes, and appear cloven.
2. They have a complex stomach in several compartments.
3. They have a peculiar bone in the leg, called the '*cannon bone*.'
4. They mostly have no front teeth in the upper jaw.

107. Of what compartments does the stomach consist?

The '*rumen*' or paunch, the '*reticulum*,' the '*psalterium*,' and the '*abomasum*' or true stomach.

108. What is the paunch?

It is a large bag nearest the throat, into which the food is placed as a reservoir, and from whence it is sent to the mouth again by the reticulum.

109. What is the reticulum?

It is a small bag whose inner surface is honeycombed, it prepares the food for its return to the mouth.

110. What is the psalterium?

It is a small bag, full of folds, inside where digestion commences, which is completed in the true stomach.

111. What is the cannon bone?

It is formed by the two metacarpal or metatarsal bones anchylosed together, and forming one bone, almost as long as the tibia.

112. What kind of teeth have they?

In the lower jaw they have eight cutting teeth, the two outside ones being called canines, and in both they have six molar teeth ridged on the top, for grinding the food.

113. What are the chief families of the *Ruminants*?

The Camels, the Musk-deer, the True Deer, the Camelopard and the Cavicorns.

114. What are the peculiarities of the Camels?

They have both incisors and canines in their upper jaw; and their feet are only imperfectly hoofed, and they have no horns.

115. Which are the chief of the Camels?

The Dromedary, with one hump on the back;
The Bactrian Camel, with two; and
The Llamas and Alpacas.

116. What are the peculiarities of the Musk-leer?

They have canines in the upper jaw, and have no horns; and they secrete a 'musk' smelling fluid.

117. What are the peculiarities of the True Deer?

They have 'antlers' instead of horns, and these are mostly found on the males only.

118. How do antlers differ from horns?

1. They are solid and not hollow.
2. They are cast off annually.

119. What is there peculiar about the Rein-leer?

The female has antlers as well as the male.

120. What are the peculiarities of the Camel-pards?

They have two solid horns, which are not shed; their neck is exceedingly long, but has only seven vertebræ in it. Their fore legs are longer than the hind.

121. What are the peculiarities of the *Cavi-corns*?

1. They have hollow horns supported on bony horn cores, which are not shed.
2. They have two unused toes behind.

122. Which are the chief of the *Cavicorns*?

The Sheep, the Oxen, the Buffalo and the Antelopes.

123. What are the *Carnivora* and *Quadru-nana* called together?

The *Unguiculata*, because their feet have claws.

124. What are the characters of the *Carnivora*?

1. They are carnivorous.
2. Their canines are always large, and most of their molars have cutting crowns.
3. Their toes are furnished with claws.

125. Into what three sections are they formed?

The *Pinnigrada*, the *Plantigrada*, and the *Digitigrada*.

126. What are the peculiarities of the *Pinnigrada*?

They are adapted for sea life by being covered with a peculiar dense fur, and having their feet webbed, their hind ones being directed backwards, like a tail fin.

127. What animals are included in this section?

The Seals and Walrus.

128. How are these distinguished?

The Walrus has two long tusk-like canines in its upper jaw, which project downwards far below the lower jaw.

129. What are the characters of the *Plantigrada*?

The heel is placed on the ground in walking, and the claws are not retractile.

130. Which are the chief families?

The Bears, Racoons and Badgers.

131. How do they differ in their habits from the *Digitigrada*?

Except the Polar Bear, they are not exclusively *carnivorous*, and have tubercular molars for *grinding* vegetable food.

132. What are the characters of the *Digitigrada*?

They walk only on the tips of the toes, (and in many the claws are retractile, and they have rasping tongues).

133. Which are the chief families?

The Weasels, Otters, Hyænas, Dogs and Cats.

134. What is the peculiarity of the Weasels?

They are half plantigrade.

135. What are the peculiarities of the Otters?

Their feet are webbed for swimming, and they live upon fish.

136. Which are the chief of the Dog family?

Wolves, Dogs, Foxes, Jackals.

137. How are they distinguished from the Cats?

By their long jaws, smooth tongues, and non-retractile claws.

138. Which are the chief of the Cat family?

Lions, Tigers, Jaguars, Leopards, Cats.

139. What are the characters of the *Quadrumana*?

1. Both fore and hind limbs are formed for prehension.
2. Their molars are broad and knobbed.

140. Into what sections are they divided?

The *Strepsirhina*, the *Platyrhina* and the *Catarhina*.

141. Where are these sections chiefly found?

The *Strepsirhina* chiefly in Madagascar.

The *Platyrhina* in the New World only.

The *Catarhina* in Africa and Asia.

142. What are the characters of the *Strepsirhina*?

Their nostrils are twisted, (whence the name).
Their second toe has a claw.

143. Which are the chief of this section?

The Ayes-ayes and Lemurs.

144. What are the characters of the *Platyrhina*?

Their nostrils are far apart, (whence the name).
Many have prehensile tails.
Their thumbs are wanting or not opposable.

145. What are the characters of the *Catarhina*?

Their nostrils are close together, (whence the name).
All their thumbs are opposable.

146. Which are the chief kinds of them?

The Common Monkey, the Baboons, and the Anthropoid Apes.

147. Why are they called Anthropoid Apes?

Because they approach nearest to man, in structure, in appearance, and in standing erect.

148. Which are the chief of them?

The Gibbous, Ouran Outang, Chimpanzee, and Gorilla.

149. What is included in the order Bimana?

Man alone.

150. In what anatomical structures does Man differ from the Anthropoid Apes?

1. The brain is larger and more convoluted, the cerebrum overlaps the cerebellum, and has what is called a '*third horn*.'

2. The feet can only be used for walking, and do not form hands.
3. The arms are shorter than the legs, while in the apes they are longer.
4. He always walks upright.
5. The canines do not project beyond the other teeth, and all the teeth are close together, instead of leaving a space.
6. He is not covered with hair.

151. Are these the only distinctions?

No; his mental distinctions are not here taken count of.

INDEX.

ABD

ABDOMEN, 45
  Abdominal region, 103
Abomasum, 147
Abranchiata, 41, 102
Acalephæ, 12
Acanthocephala, 38
Acanthometrina, 6
Acanthopteri, 107, 108
Acarina, 59
Acephala, 84
Acineta, 11
Actinidæ, 21
Actinosoma, 20
Actinozoa, 12, 19
Adductor muscles, 85
Adelarthrosomata, 58
Alcyonaria, 20, 24
Alcyonidæ, 24
Alveolus, 96
Amœbea, 4
Ambulacra, 28
Ambulacral system, 28
Ametabola, 67
Amphibia, 113
Amphipoda, 51
Anacanthini, 107, 108
Anal fins, 104
Annelida, 40, 41
Annuloida, 2, 27
Annulosa, 2, 39
Anomodontia, 123
Anomura, 54, 56

BEA

Anoplura, 67
Anterior side, 84
Antlia, 65
Anura, 114
Aperture, 89
Aphaniptera, 73
Apical disc, 28
Aporosa, 23
Aptera, 67
Arachnida, 44, 57
Araneida, 60
Archencephala, 136
Aristotle's lantern, 30
Arterial bulb, 104
Arthropoda, 40–44
Articulata, 82
Artiodactyla, 139, 146
Ascidians, 78
Asiphonida, 87
Asteroids, 28–31
Atlas, 134
Atrial system, 82
Auricle, 83
Autophagi, 128
Avicularia, 78
Axis, 134

BALEEN, 143
  Barbs, 125
Barbules, 125
Beak, 81–84

BEL

Belemnite, 95
Bile, 101
Bimana, 139
Birds, 125
Blastoids, 34
Blood-corpuscles, 101
Body whorl, 89
Brachiopoda, 76–80
Brachyura, 54–57
Branchial arches, 105
Branchial sac, 79
Branchiata, 41, 102
Branchifera, 90
Branchiostegal rays, 103
Brevipennatæ, 130
Bruta, 139–141
Byssus, 86

CADUCIBRANCHIATA, 113, 114
Calice, 23
Calycophoridæ, 16
Campanularida, 12–15
Canines, 135
Cannon bone, 147
Capitulum, 47
Carapace, 47, 119
Carinatæ, 128
Carnivora, 139, 150
Carpal bones, 100
Carpophaga, 138
Cartilage, 85
Catarhina, 151
Caudal fins, 104
Caudal region, 100–103
Cavicorns, 149
Centrum, 98
Cephalobranchiata, 43
Cephalopoda, 88–93
Cephalothorax, 57
Cerebellum, 136
Cerebrum, 136
Cervical region, 99
Cetacea, 139–142

CYC

Chætognatha, 38
Cheiroptera, 139–141
Chelonia, 116
Chilognatha, 62
Chilopoda, 62
Chyle, 101
Chyme, 101
Cilia, 8
Ciliata, 9
Circular canals, 29
Cirrhus, 44
Cirri, 46, 82
Cirripedia, 45
Cirristomi, 105, 106
Cladocera, 47
Clavicle, 100
Cloaca, 35, 79
Cœlenterata, 2–11
Cœnosarc, 14
Coleoptera, 73–75
Columacei, 131
Columella, 23, 89
Conchifera, 84
Conical, 89
Conirostres, 133
Contractile vesicle, 5
Copepoda, 47
Coracoid, 100
Corallite, 23
Corpus callosum, 136
Corynida, 13
Costal plates, 119
Coxa, 64
Crinoids, 28–33
Crocodilia, 118–122
Crustacea, 44
Ctenocyst, 26
Ctenoid, 103
Ctenophora, 12, 25
Ctenophores, 25
Ctenophoral canals, 26
Cultirostres, 131
Cursores, 129
Cuttle bone, 96
Cycloid scales, 102

CTC

105, 106

4

DA, 53, 95
uous teeth, 135
s, 133
ta, 94
137
, 150
ata, 61
86
, 123
t, 135
5
3
89
, 12, 17

s, 104
ion, 99
e, 84
sel, 66
chiata, 43

)DERMATA, 27
noids, 28
, 11
4
almata, 51
)
, 84–88
, 11
te, 54
, 4
eton, 103
9
haga, 138
raca, 45–47
idæ, 72
, 54
7

HÆM

Errantia, 40–43
Eurostomata, 26
Eurypterida, 50
Exopodite, 54
Exoskeleton, 103

FEMUR, 64, 100
Fibula, 101
Fishes, 102
Fissirostres, 133
Flagellata, 9–11
Foot, 56
Foot-jaws, 83
Foramen, 5, 81
Foraminifera, 4, 5
Funnel, 93
Furculum, 127

GALLINACEI, 131
Ganoid scales, 103
Ganoidei, 105, 109
Gasteropoda, 88
Gastric juice, 101
Gemmation, 13
Genital plates, 29
Gephyrea, 40, 41
Glass hand, 46
Gonoblastidia, 14
Gonophores, 14
Gonotheca, 15
Gordiacea, 38
Gorgonidæ, 24
Grallatores, 130, 131
Graptolites, 19
Gregarinida, 3
Guard, 96
Gymnolæmata, 78
Gymnosomata, 93
Gyrencephala, 136

HÆMAL ARCH, 99
Hæmal spine, 99
Hæmapophyses, 99

HAL

Halteres, 73
Helminthozoa, 35
Hemimetabola, 67
Hemiptera, 68, 69
Herbivorous Cetacea, 144
Heterocercal, 104
Heterogangliata, 76
Heterophagi, 128
Heteropoda, 93
Heteroptera, 69
Hinge line, 85
Hirudinea, 40, 41
Holocephali, 111
Holometabola, 67
Holostomata, 91
Holothuroids, 28, 35
Homocercal, 104
Homogangliata, 40
Homoptera, 69
Humerus, 100
Hydra, 12, 13
Hydra-tuba, 19
Hydrida, 12
Hydroida, 12, 77
Hydrorhiza, 12
Hydrosoma, 20
Hydrotheca, 15
Hydrozoa, 12
Hymenoptera, 73, 74
Hyoid bones, 104
Hyracoidea, 146

ICHTHYOPSIDA, 102
Ichthyopterygia, 123
Ilium, 100
Ilyanthidæ, 21
Imago, 67
Imperforata, 6, 89
Implacental, 136
Inarticulata, 82
Incisors, 135
Inferior larynx, 128
Infusoria, 3–9, 38
Innominate bone, 100

MAL

Inoperculata, 92
Insecta, 44–63
Insectivora, 139, 140
Insessores, 130–133
Integropallialia, 87
Interambulacra, 28
Interspinous bones, 104
Intestinal juice, 101
Ischium, 100
Isopoda, 51
Iulus, 63

LABIUM, 58, 65
Labrum, 65
Labyrinthodontia, 116
Lacertilia, 118–121
Lacteals, 98
Lady-in-the-lobster, 55
Læmodipoda, 51
Lamellibranchiata, 84
Lamellirostres, 130
Lepidoganoids, 110
Lepidoptera, 73, 74
Lepidosiren, 112
Ligament, 85
Limulus, 50
Lissencephala, 136
Lithocyst, 17
Loculi, 23
Longipennatæ, 130
Longirostres, 131
Lophobranchii, 107–109
Loricata, 117
Lucernaridæ, 9
Lumbar region, 99
Lyencephala, 136
Lymphatics, 98

MACRODACTYLI, 141
Macrura, 54
Madreporiform tubercle, 29
Malacodermata, 21
Malacopteri, 107

MAL
ı, 45
67
tubes, 65
102–134
55, 65
85, 94
ates, 119
ones, 137
, 137
–65
alps, 65
3, 55
, 102–104
6
urses, 111
ı, 45–49
, 20
64
bones, 100
101
64

76
, 76
ı, 137
mata, 58
, 86
nt, 135–139
a, 137
88
145
:4
44, 62

RES, 130
alyx, 16
, 36
38
36
t
, 99
e, 99
ses, 98
68–71

PER
Neuters, 66
Notched, 89
Notochord, 106
Nucleobranchiata, 91
Nucleus, 4, 89
Nudibranchiata, 92

OCTOPODA, 95
Ocular plates, 29
Odontoid process, 135
Odontophore, 88
Oligochæta, 40–42
Omnivora, 146
Opercular bones, 103
Operculum, 50, 90
Ophidia, 118, 119
Ophiomorpha, 114
Ophiuroids, 28–32
Opisthobranchiata, 91
Ornithodelphia, 137
Orthoptera, 68–70
Oscula, 8
Ostracoda, 47

PACHYDERMATA, 147
Palliobranchiata, 80
Pallium, 85
Palpi, 58
Pancreatic juice, 101
Patagium, 141
Pectoral arch, 100
Pectoral fins, 104
Pectostraca, 45
Pedicellariæ, 32
Pedicle, 81
Pedipalpi, 60
Peduncle, 47
Pelagidæ, 18
Pelvic arch, 100
Pen, 96
Pennatulidæ, 24
Pentastomida, 59
Perennibranchiata, 113, 114

PER

Perforata, 23
Perforate, 6, 89
Perissodactyla, 139, 145
Permanent teeth, 135
Phalanges, 100, 101
Phragmocone, 96
Phylactolæmata, 78
Phyllopoda, 47
Physophoridæ, 16
Pinnate, 24
Placoganoids, 110
Placoid scales, 103
Placoidei, 105, 110
Plagiostomi, 111
Planarida, 36
Plantigrada, 150
Planula, 19
Plastron, 119
Platyelmia, 36
Platyrhina, 151
Plectognathi, 107, 108
Pleura, 54
Pleurapophyses, 99
Ploughshare bone, 126
Pneumatophore, 16
Podophthalmata, 51
Podosomata, 50, 59
Poephaga, 138
Polycystina, 6
Polypary, 14
Polype, 20
Polypite, 14, 20
Polyzoa, 76
Polyzoarium, 76
Porifera, 3–7
Poriferous zones, 28
Posterior side, 84
Premolars, 135
Pressirostres, 131
Proboscidea, 139–144
Proglottis, 36
Prosobranchiata, 91
Prothorax, 64
Protopodite, 54
Protozoa, 2, 3

SAR

Proventriculus, 127
Proximal, 13
Psalterium, 147
Pseudopodia, 3
Pteropoda, 88, 93
Pterosauria, 123
Pubes, 100
Pulmonaria, 58
Pulmonary sacs, 58
Pulmonifera, 90
Pupa, 67
Pygidium, 49

QUADRATE BONE, 117
Quadrumana, 137

RADIATING CANALS, 29
Radiolaria, 4
Radius, 100
Raptores, 130–133
Rasores, 130, 131
Ratitæ, 128
Respiratory tree, 35
Reticularia, 5
Reticulum, 147
Rhizocephala, 47
Rhizophaga, 138
Rhizopoda, 3
Rhizostomidæ, 18
Rodentia, 139
Rotifera, 35–38
Rugosa, 24
Rumen, 147
Ruminantia, 146, 147

SACRAL REGION, 99
Sacrum, 101
Saliva, 101
Sand canal, 29
Sarcode, 3

SAR

Sarcophaga, 138
Scansores, 130–132
Sauropsida, 102
Sauropterygia, 123
Saururæ, 128
Scapula, 100
Scapular arch, 100
Sclerobasica, 21
Sclerodermata, 21
Scolecida, 27, 35
Scolex, 37
Scolopendra, 63
Scyphistoma, 19
Segmental organs, 41
Septa, 23, 97
Sertularida, 12–14
Serum, 101
Shaft, 125
Sinistral, 88
Sinupallialia, 86
Siphonida, 87
Siphonophora, 12–15
Siphonostomata, 91
Siphons, 86
Siphuncle, 96, 97
Sirenia, 139–142
Solidungula, 145
Somatocyst, 16
Somites, 45
Spicules, 8
Spines, 28
Spinnerets, 61
Spire, 89
Squamata, 117
Stenostomata, 26
Sternal ribs, 126
Sternum, 54
Stigmata, 41
Stomapoda, 53
Strepsiptera, 73–75
Strepsirhina, 151
Suctoria, 9, 11
Suture, 89, 97
Swimmerets, 53
Synapta, 35

UNG

TABULÆ, 23
Tabulata, 23
Tæniadæ, 35
Tardigrada, 59
Tarso-metatarsus, 127
Tarsus, 64, 101
Tectibranchiata, 92
Teleostei, 105–107
Telson, 45
Tenuirostres, 133
Tergum, 54
Test, 28
Tetrabranchiata, 94
Thalassicollida, 6, 7
Theca, 22
Thecosomata, 93
Thorax, 45
Thread cells, 11
Thysanura, 67
Tibia, 101
Totipalmatæ, 130
Trachea, 58, 62, 63
Trachearia, 58
Transverse processes, 99
Trematoda, 36
Trichoptera, 72
Trilobites, 49
Trochanter, 64
Trochoid, 89
Trunk, 65
Tubercles, 28
Tubicola, 40–43
Tubiporidæ, 24
Tubulosa, 23
Tunicata, 76–78
Turbellaria, 36
Turbinated, 89
Turreted, 89

ULNA, 100
Umbilicus, 89
Umbo, 84
Umbrella, 17
Unguiculata, 149

UNG

Ungulata, 144
Univalve, 88
Urodela, 114

VARICES, 89
Ventral fins, 104
Ventral side, 84
Ventricle, 83
Vertebræ, 98
Vertebrata, 2–98
Vibracula, 78

ZYG

WATER VASCULAR SYSTEM, 27
Webs, 125
Wheel animalcules, 38
Whorls, 89

XIPHOSURA, 50

ZOANTHARIA, 20
Zoanthidæ, 21
Zygapophyses, 99

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